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SchweserNotes™

Foundations of Risk Management

PART I | **BOOK 1**

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FRM® Exam Part I

FRM®

Welcome

As the head of Advanced Designations at Kaplan Schweser, I am pleased to have the opportunity to help you prepare for the FRM® exam. Kaplan Schweser has decades of experience in delivering the most effective FRM exam prep products in the market and I know you will find them to be invaluable in your studies.

Our products are designed to be an integrated study solution across print and digital media to provide you with the best learning experience, whether you are studying with a physical book, online, or on your mobile device.

Our core product, the SchweserNotes™, addresses all Topic Areas, Readings, and Learning Objectives in the FRM curriculum. Each reading in the SchweserNotes has been broken into smaller, bite-sized modules with Module Quizzes interspersed throughout to help you continually assess your comprehension. Topic Quizzes and Checkpoint Exams appear online to help you gauge your knowledge of the material before you move on to the next section.

All purchasers of the SchweserNotes receive online access to the Kaplan Schweser online platform (our learning management system or LMS) at www.schweser.com. On the LMS, you will see a dashboard that tracks your overall progress and performance as well as an Activity Feed, which provides structure and organization to the tasks required to prepare for the FRM exam. You also have access to the online versions of the SchweserNotes and Module Quizzes. Look for the icons indicating where Module Quizzes are available online. I strongly encourage you to enter your Module Quiz answers online and use the dashboard to track your progress and stay motivated.

Again, thank you for trusting Kaplan Schweser with your FRM exam preparation. We're here to help you throughout your journey to become a certified Financial Risk Manager.

Regards,

Derek Burkett

Derek Burkett, CFA, FRM, CAIA
Vice President (Advanced Designations)

Contact us for questions about your study package, upgrading your package, purchasing additional study materials, or for additional information:

888.325.5072 (U.S.) | +1 608.779.8327 (Int'l.)

staff@schweser.com | www.schweser.com/cfa

Book 1: Foundations of Risk Management

SchweserNotes™ 2022

FRM Part I

SCHWESERNOTES™ 2022 FRM® PART I BOOK 1: FOUNDATIONS OF RISK MANAGEMENT

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WELCOME TO THE 2022 SCHWESERNOTES™

Thank you for trusting Kaplan Schweser to help you reach your career and educational goals. We are very pleased to be able to help you prepare for the FRM Part I exam. In this introduction, I want to explain the resources included with the SchweserNotes, suggest how you can best use Kaplan Schweser materials to prepare for the exam, and direct you toward other educational resources you will find helpful as you study for the exam.

Besides the SchweserNotes themselves, there are many online educational resources available at Schweser.com. Just log in using the individual username and password you received after purchasing the SchweserNotes.

SchweserNotes™

The SchweserNotes consist of four volumes that include complete coverage of all FRM assigned readings and learning objectives as well as module quizzes (multiple-choice questions for every reading) to help you master the material and check your retention of key concepts.

Practice Questions

To retain the material, it is important to quiz yourself often. We offer an online version of the SchweserPro™ QBank, which contains hundreds of Part I practice questions and explanations. We also offer Topic Quizzes and Checkpoint Exams online to further help you retain and apply what you have learned.

Mock Exams

Schweser offers four full 4-hour, 100-question practice exams. These online exams are important tools for gaining the speed and skills you will need to pass the exam. The Mock Exams contain answers with full explanations for self-grading and evaluation.

OnDemand Class

Our OnDemand Class provides comprehensive online instruction of every reading in the FRM curriculum. This video lecture series brings the personal attention of a classroom into your home or office with over 30 hours of instruction. The class offers in-depth coverage of difficult concepts as well as a discussion of sample exam questions. All videos are available for viewing at any time throughout the season. Candidates enrolled in the OnDemand Class also have the ability to email questions to the instructor at any time.

Late-Season Review

Late-season review and exam practice can make all the difference. Our OnDemand Review Package helps you evaluate your exam readiness with products specifically designed for

late-season studying. This study package includes the OnDemand Review (8-hour archived online workshop covering essential curriculum topics) and Schweser's Secret Sauce® (concise summary of the FRM curriculum).

Part I Exam Weightings

When preparing for the exam, be familiar with the weights assigned to each topic area within the curriculum. The Part I exam weights and questions are as follows:

Book	Topic Area	Exam Weight	Exam Questions
1	Foundations of Risk Management	20%	20
2	Quantitative Analysis	20%	20
3	Financial Markets and Products	30%	30
4	Valuation and Risk Models	30%	30

How to Succeed

The FRM Part I exam is a formidable challenge (covering 60 assigned readings and almost 500 learning objectives), so you must devote considerable time and effort to be properly prepared. There are no shortcuts! You must learn the material, know the terminology and techniques, understand the concepts, and be able to answer 100 multiple-choice questions quickly and (at least 70%) correctly. A good estimate of the study time required is 250 hours on average, but some candidates will need more or less time, depending on their individual backgrounds and experience.

Expect the Global Association of Risk Professionals (GARP) to test your knowledge in a way that will reveal how well you know the Part I curriculum. You should begin studying early and stick to your study plan. You should first read the SchweserNotes and complete the practice questions for each reading. After completing each book, you should answer the provided topic quiz questions to understand how concepts may be tested on the exam.

It is recommended that you finish your initial study of the entire curriculum at least two weeks (earlier if possible) prior to your exam window to allow sufficient time for practice and targeted review. During this period, you should take all of your Schweser Mock Exams. This final review period is when you will get a clear indication of how effective your study efforts have been and which readings require significant additional review. Answering exam-like questions across all readings and working on your exam time management skills will be important determinants of your success on exam day.

Best regards,

Eric Smith

Eric Smith, CFA, FRM

Kaplan Schweser

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READINGS AND LEARNING OBJECTIVES

STUDY SESSIO N 1

1. The Building Blocks of Risk Management

Global Association of Risk Professionals. ***Foundations of Risk Management***. New York, NY: Pearson, 2019. Chapter 1.

After completing this reading, you should be able to:

a. explain the concept of risk and compare risk management with risk-taking.
b. evaluate, compare, and apply tools and procedures used to measure and manage risk, including quantitative measures, qualitative risk assessment techniques, and enterprise risk management.
c. distinguish between expected loss and unexpected loss and provide examples of each.
d. interpret the relationship between risk and reward, and explain how conflicts of interest can impact risk management.
e. describe and differentiate between the key classes of risks, explain how each type of risk can arise, and assess the potential impact of each type of risk on an organization.
f. explain how risk factors can interact with each other and describe challenges in aggregating risk exposures.

2. How Do Firms Manage Financial Risk?

Global Association of Risk Professionals. ***Foundations of Risk Management***. New York, NY: Pearson, 2019. Chapter 2.

After completing this reading, you should be able to:

a. compare different strategies a firm can use to manage its risk exposures and explain situations in which a firm would want to use each strategy.
b. explain the relationship between risk appetite and a firm's risk management decisions.
c. evaluate some advantages and disadvantages of hedging risk exposures, and explain challenges that can arise when implementing a hedging strategy.
d. apply appropriate methods to hedge operational and financial risks, including pricing, foreign currency, and interest rate risk.
e. assess the impact of risk management tools and instruments, including risk limits and derivatives.

3. The Governance of Risk Management

Global Association of Risk Professionals. ***Foundations of Risk Management***. New York, NY: Pearson, 2019. Chapter 3.

After completing this reading, you should be able to:

a. explain changes in regulations and corporate risk governance that occurred as a result of the 2007-2009 financial crisis.
b. describe best practices for the governance of a firm's risk management processes.
c. explain the risk management roles and responsibilities of a firm's board of directors.

d. evaluate the relationship between a firm's risk appetite and its business strategy, including the role of incentives.
e. illustrate the interdependence of functional units within a firm as it relates to risk management.
f. assess the role and responsibilities of a firm's audit committee.

4. Credit Risk Transfer Mechanisms

Global Association of Risk Professionals. ***Foundations of Risk Management***. New York, NY: Pearson, 2019. Chapter 4.

After completing this reading, you should be able to:

a. compare different types of credit derivatives, explain their applications, and describe their advantages.
b. explain different traditional approaches or mechanisms that firms can use to help mitigate credit risk.
c. evaluate the role of credit derivatives in the 2007-2009 financial crisis and explain changes in the credit derivative market that occurred as a result of the crisis.
d. explain the process of securitization, describe a special purpose vehicle (SPV), and assess the risk of different business models that banks can use for securitized products.

STUDY SESSIO N 2

5. Modern Portfolio Theory (MPT) and the Capital Asset Pricing Model (CAPM)

Global Association of Risk Professionals. ***Foundations of Risk Management***. New York, NY: Pearson, 2019. Chapter 5.

After completing this reading, you should be able to:

a. explain MPT and interpret the Markowitz efficient frontier.
b. understand the derivation and components of the CAPM.
c. describe the assumptions underlying the CAPM.
d. interpret and compare the capital market line and the security market line.
e. apply the CAPM in calculating the expected return on an asset.
f. interpret beta and calculate the beta of a single asset or portfolio.
g. calculate, compare, and interpret the following performance measures: the Sharpe performance index, the Treynor performance index, the Jensen performance index, the tracking error, information ratio, and Sortino ratio.

6. The Arbitrage Pricing Theory and Multifactor Models of Risk and Return

Global Association of Risk Professionals. ***Foundations of Risk Management***. New York, NY: Pearson, 2019. Chapter 6.

After completing this reading, you should be able to:

a. explain the Arbitrage Pricing Theory (APT), describe its assumptions, and compare the APT to the CAPM.
b. describe the inputs (including factor betas) to a multifactor model and explain the challenges of using multifactor models in hedging.

c. calculate the expected return of an asset using a single-factor and a multifactor model.
d. explain how to construct a portfolio to hedge exposure to multiple factors.
e. describe and apply the Fama-French three-factor model in estimating asset returns.

7. Principles for Effective Data Aggregation and Risk Reporting

Global Association of Risk Professionals. ***Foundations of Risk Management***. New York, NY: Pearson, 2019. Chapter 7.

After completing this reading, you should be able to:

a. explain the potential benefits of having effective risk data aggregation and reporting.
b. explain challenges to the implementation of a strong risk data aggregation and reporting process and the potential impacts of using poor-quality data.
c. describe key governance principles related to risk data aggregation and risk reporting.
d. describe characteristics of effective data architecture, IT infrastructure, and risk-reporting practices.

8. Enterprise Risk Management (ERM) and Future Trends

Global Association of Risk Professionals. ***Foundations of Risk Management***. New York, NY: Pearson, 2019. Chapter 8.

After completing this reading, you should be able to:

a. describe ERM and compare an ERM program with a traditional silo-based risk management program.
b. describe the motivations for a firm to adopt an ERM initiative.
c. explain best practices for the governance and implementation of an ERM program.
d. describe risk culture, explain the characteristics of a strong corporate risk culture, and describe challenges to the establishment of a strong risk culture at a firm.
e. explain the role of scenario analysis in the implementation of an ERM program and describe its advantages and disadvantages.
f. explain the use of scenario analysis in stress testing programs and capital planning.

STUDY SESSION 3

9. Learning from Financial Disasters

Global Association of Risk Professionals. ***Foundations of Risk Management***. New York, NY: Pearson, 2019. Chapter 9.

After completing this reading, you should be able to:

a. analyze the key factors that led to and derive the lessons learned from case studies involving the following risk factors:

- Interest rate risk, including the 1980s savings and loan crisis in the U.S.
- Funding liquidity risk, including Lehman Brothers, Continental Illinois, and Northern Rock.
- Implementing hedging strategies, including the Metallgesellschaft case.
- Model risk, including the Niederhoffer case, Long Term Capital Management, and the London Whale case.

- Rogue trading and misleading reporting, including the Barings case.
- Financial engineering and complex derivatives, including Bankers Trust, the Orange County case, and Sachsen Landesbank.
- Reputational risk, including the Volkswagen case.
- Corporate governance, including the Enron case.
- Cyber risk, including the SWIFT case.

10. Anatomy of the Great Financial Crisis of 2007–2009

Global Association of Risk Professionals. ***Foundations of Risk Management***. New York, NY: Pearson, 2019. Chapter 10.

After completing this reading, you should be able to:

a. describe the historical background and provide an overview of the 2007-2009 financial crisis.
b. describe the build-up to the financial crisis and the factors that played an important role.
c. explain the role of subprime mortgages and collateralized debt obligations (CDOs) in the crisis.
d. compare the roles of different types of institutions in the financial crisis, including banks, financial intermediaries, mortgage brokers and lenders, and rating agencies.
e. describe trends in the short-term wholesale funding markets that contributed to the financial crisis, including their impact on systemic risk.
f. describe responses made by central banks in response to the crisis.

11. GARP Code of Conduct

Global Association of Risk Professionals. ***Foundations of Risk Management***. New York, NY: Pearson, 2019. Chapter 11.

After completing this reading, you should be able to:

a. describe the responsibility of each GARP Member with respect to professional integrity, ethical conduct, conflicts of interest, confidentiality of information, and adherence to generally accepted practices in risk management.
b. describe the potential consequences of violating the GARP Code of Conduct.

The following is a review of the Foundations of Risk Management principles designed to address the learning objectives set forth by GARP®. Cross-reference to GARP FRM Part I Foundations of Risk Management, Chapter 1.

Reading 1

THE BUILDING BLOCKS OF RISK MANAGEMENT

Study Session 1

EXAM FOCUS

This introductory reading provides coverage of fundamental risk management concepts that will be discussed in much more detail throughout the FRM curriculum. For the exam, it is important to understand the general risk management process and its potential shortcomings, the concept of unexpected loss, and some of the underlying points regarding the relationship between risk and reward. Also, the material on the main categories of financial and nonfinancial risks contains several testable concepts.

MODULE 1.1: INTRODUCTION TO RISK MANAGEMENT

LO 1.a: Explain the concept of risk and compare risk management with risk-taking.

In an investing context, **risk** is the uncertainty surrounding outcomes. Investors are generally more concerned about negative outcomes (unexpected investment losses) than they are about positive surprises (unexpected investment gains). Additionally, there is an observed natural trade-off between risk and return; opportunities with high risk have the potential for high returns and those with lower risk also have lower return potential.

Risk is not necessarily related to the size of the potential loss. For example, many potential losses are large but are quite predictable and can be accounted for using risk management techniques. The more important concern is the variability of the loss, especially an unexpected loss that could rise to unexpectedly high levels.

As a starting point, **risk management** includes the sequence of activities aimed to reduce or eliminate an entity’s potential to incur expected losses. On top of that, there is the need to manage the unexpected variability of some costs. In managing both expected and unexpected losses, risk management can be thought of as a defensive technique. However, risk management is actually broader in the sense that it considers how an entity can consciously determine how much risk it is willing to take to earn future uncertain returns. The concept of **risk taking** refers to the active acceptance of incremental risk in the pursuit of incremental gains. In this context, risk taking can be thought of as an opportunistic action.

The Risk Management Process

The **risk management process** is a formal series of actions designed to determine if the perceived reward justifies the expected risks. A related query is whether the risks could be reduced and still provide an approximately similar reward.

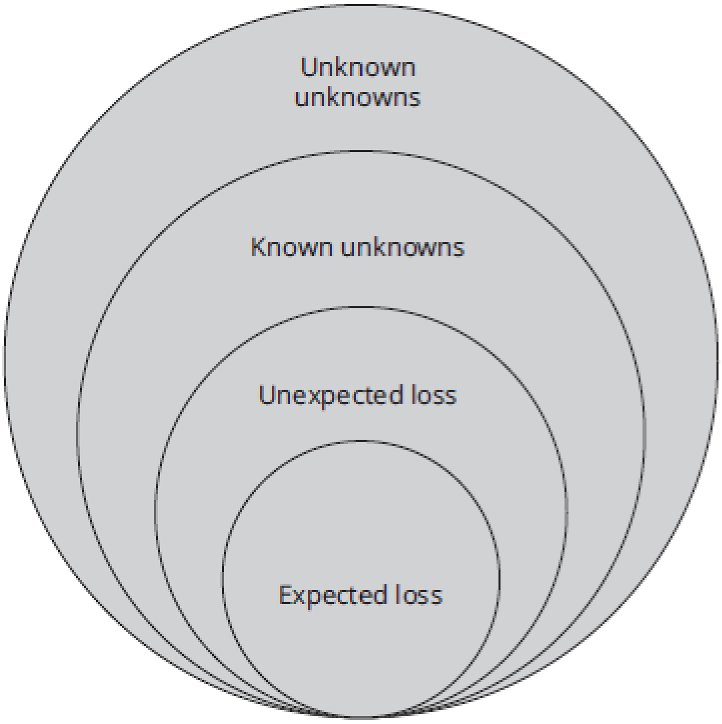
There are several core building blocks in the risk management process. They are as follows:

1. Identify risks.
2. Measure and manage risks.
3. Distinguish between expected and unexpected risks.
4. Address the relationships among risks.
5. Develop a risk mitigation strategy.
6. Monitor the risk mitigation strategy and adjust as needed.

Risk managers can deploy several methods to identify relevant risks. The various types of risk are discussed later in this reading, but for now, focus on the identification process. One method to identify risks is brainstorming, which involves soliciting from key business leaders all potential known risks influencing their supervision area. These key leaders may also survey their subordinates (and especially frontline personnel) for a deeper understanding of relevant risks. There may be industry-level resources (e.g., regulatory standards, industry surveys, or expert opinions) that are also available. For a more quantitative approach, a risk manager can analyze actual loss data to discern the magnitudes and frequency of various losses. Scenario analysis is another common tool used for identifying risks.

Part of the risk identification process is to filter risks into degrees of being known or unknown. Figure 1.1 illustrates that risks can move along a spectrum from being expected (i.e., known) to being fully unknown. The unknown category can be subdivided into the *known unknowns* (i.e., *Knightian uncertainty*) and the *unknown unknowns*. The former are items that may impact a firm, while the latter are truly unknown (i.e., tail risk events). Where possible, risk managers should move a risk into the known category, but this does not work for risks that cannot be quantified.

Figure 1.1: Loss Categories



The risk management process involves a four-way decision. The company might decide to *avoid* risk directly by selling a product line, avoiding certain markets or jurisdictions, or offshoring production. They also might decide to *retain* risk, depending on the expected rewards relative to the probability and frequency of any expected losses. Another option is to *mitigate* risk by reducing either the magnitude or the frequency of exposure to a given risk factor. Finally, risk managers could *transfer* risk to a third party using derivatives or structured products. They could also purchase insurance to outsource risk to an insurance company.

One of the challenges in ensuring that risk management will be beneficial to the economy is that risk must be sufficiently dispersed among willing and able participants in the economy. Unfortunately, a notable failure of risk management occurred during the financial crisis of 2007–2009 when it was subsequently discovered that risk was too concentrated among too few participants.

Another challenge of the risk management process is that it has failed to consistently assist in preventing market disruptions or preventing financial accounting fraud (due to corporate governance failures). For example, the existence of derivative financial instruments greatly facilitates the ability to assume high levels of risk and the tendency of risk managers to follow each other's actions (e.g., selling risky assets during a market crisis, which disrupts the market by increasing its volatility).

In addition, the use of derivatives as complex trading strategies assisted in overstating the financial position (i.e., net assets on balance sheet) of many entities and complicating the level of risk assumed by many entities. Even with the best risk management policies in place, using such inaccurate information would not allow the policies to be effective.

Finally, risk management may not be effective on an overall economic basis because it only involves risk transferring by one party and risk assumption by another party. It does not

result in overall risk elimination. In other words, risk management can be thought of as a *zero-sum game* in that some “winning” parties will gain at the expense of some “losing” parties. However, if enough parties suffer devastating losses due to an excessive assumption of risk, it could lead to a widespread economic crisis.

Measuring and Managing Risk

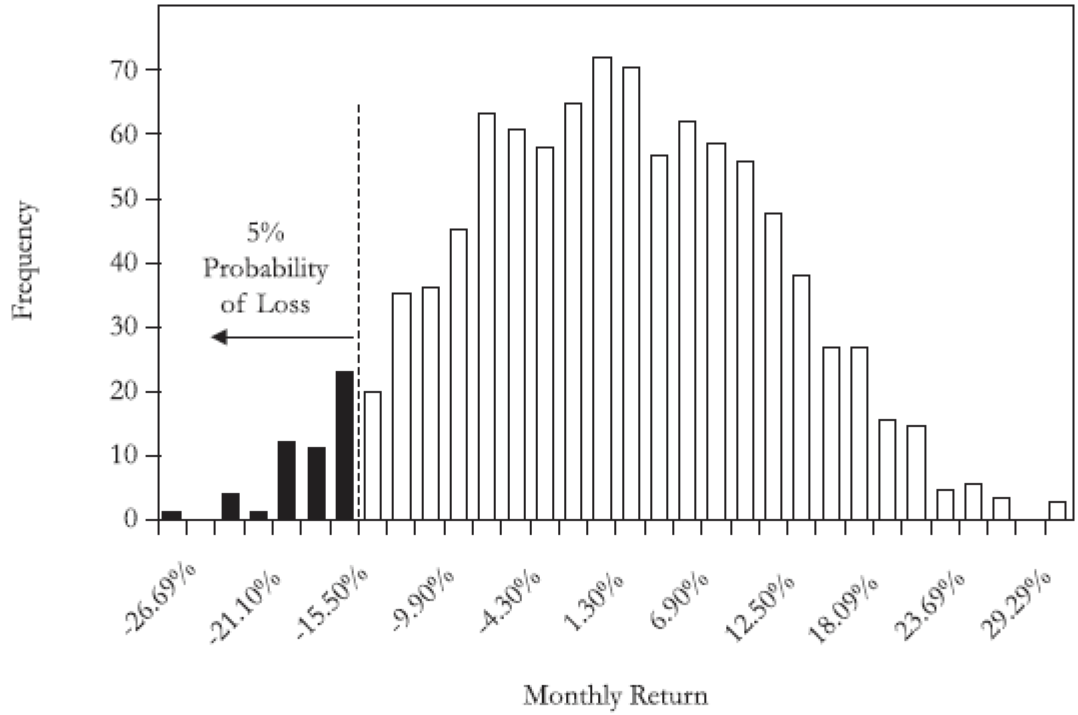
LO 1.b: Evaluate, compare, and apply tools and procedures used to measure and manage risk, including quantitative measures, qualitative risk assessment techniques, and enterprise risk management.

Quantitative Risk Measures

Value at risk (VaR) calculates an estimated loss amount given a certain probability of occurrence. For example, a financial institution may have a one-day VaR of $2.5 million at the 95% confidence level. That would be interpreted as having a 5% chance that there will be a loss greater than $2.5 million on any given day. VaR is a useful measure for liquid positions operating under normal market circumstances over a short period of time. It is less useful and potentially dangerous when attempting to measure risk in non-normal circumstances, in illiquid positions, and over a long period of time.

To further illustrate the concept of VaR, assume you have gathered 1,000 monthly returns for a security, and produced the histogram shown in Figure 1.2. You decide that you want to compute the monthly VaR for this security at a confidence level of 95%. At a 95% confidence level, the lower tail displays the lowest 5% of the underlying distribution’s returns. For this distribution, the value associated with a 95% confidence level is a return of −15.5%. If you have $1,000,000 invested in this security, the one-month VaR is $155,000 (−15.5% × $1,000,000).

Figure 1.2: Histogram of Monthly Returns



PROFESSOR'S NOTE

The VaR calculated using Figure 1.2 is an example of historical VaR. In Book 4, you will learn about other approaches for calculating VaR.

Economic capital is the amount of liquid capital necessary to cover unexpected losses. For example, if one-day VaR is $2.5 million and the entity holds $2.5 million in liquid reserves, then they have sufficient economic capital (i.e., they are unlikely to go bankrupt in a one-day expected tail risk event).

Qualitative Risk Assessment

Scenario analysis is a process that considers potential future risk factors and the associated alternative outcomes. The typical method is to compare a best-case scenario to a worst-case scenario, which shocks variables to their extreme known values. This process factors the potential impact of several categories of risk and influences risk manager decision making by attempting to put a value on an otherwise qualitative concept (i.e., what-if analysis). This exercise is an attempt to understand the assumed full magnitude of potential losses even if the probability of the loss is very small.

Stress testing is a form of scenario analysis that examines a financial outcome based on a given "stress" on the entity. This technique adjusts one parameter at a time to estimate the impact on the firm. For example, it is plausible for interest rates to adjust severely in an economic crisis. Stress testing will estimate the impact of this one parameter on the entity.

There are two types of parameters that could be considered using either scenario analysis or stress testing. The first type of parameter is historically sourced. This parameter has the benefit of being observable, but the past trend may not continue into the future. The second type of parameter is an estimated variable, which is a hypothetical forecast based on a risk

manager's assumptions. This approach can introduce estimation error and model risk, but it may be a useful exercise to fully understand a firm's sensitivity to qualitative risk factors.

Enterprise Risk Management

In practice, the term **enterprise risk management (ERM)** refers to a general process by which risk is managed within an organization. An ERM system is highly integrative in that it is deployed at the enterprise level and not siloed at the department level. The value in this top-down approach is that risk is not considered independently, but rather in relation to its potential impact on multiple divisions of a company.

One challenge with the ERM approach is a tendency to reduce risk management to a single value (e.g., either VaR or economic capital). This attempt is too simplistic in a dynamic-risk environment. Risk managers learned from the financial crisis of 2007–2009 that risk is multi-dimensional, and it requires consideration from various vantage points. Risk also develops across different risk types, as you will learn later in this reading. The reality is that proper application of an ERM framework requires both statistical analysis and informed judgment on the part of risk managers.

The ultimate goal of an ERM is to understand company-wide risks and to integrate risk planning into strategic business planning. If the risk management process does not link information with action, then it is an exercise in futility. ERM is not just about risk aggregation at the company level. It considers risk holistically and its appropriate influence on strategic planning for an organization.

Expected and Unexpected Loss

LO 1.c: Distinguish between expected loss and unexpected loss and provide examples of each.

Expected loss (EL) considers how much an entity expects to lose in the normal course of business. These losses can be calculated through statistical analysis with relative reliability over short time horizons. The EL of a portfolio can generally be calculated as a function of: (1) the probability of a risk occurring; (2) the dollar exposure to the risk event; and (3) the expected severity of the loss if the risk event does occur.

For example, a retail business that provides credit terms on sales of goods to its customers (i.e., no need to pay immediately) incurs the risk of nonpayment by some of those customers. If the business has been in operation for at least a few years, it could use its operating history to reasonably estimate the percentage of annual credit sales that will never be collected. The amount of the loss is therefore predictable and is treated as a regular cost of doing business (i.e., bad debt expense on the income statement). It can be priced into the cost of the goods directly in the case of the retail business. In a banking context, EL could be modeled as the product of a borrower's probability of default (PD), the bank's exposure at default (EAD), and the magnitude of the loss given default (LGD).

$$EL = EAD \times PD \times LGD$$

Banks will often address ELs by charging a higher spread (and possibly a shorter time horizon) for riskier borrowers. Most expected losses can be logically considered as a

function of several more granular losses.

PROFESSOR'S NOTE

When EL can be modeled with confidence, it can be treated like a predictable expense or a variable cost.

Unexpected loss considers how much an entity could lose in excess of their average (expected) loss scenarios. There is considerable challenge involved with predicting unexpected losses because they are, by definition, unexpected.

For example, consider a commercial loan portfolio that is focused on loans to automotive manufacturing companies. During an economic expansion that favors such companies (because individuals have more disposable income to spend on items such as automobiles), the lender will realize very few, if any, loan defaults. However, during an economic recession, there is less disposable income to spend and many more loan defaults are likely to occur from borrowers. It is also likely that many of these losses will be clustered at the same time. This is an example of *correlation risk*, when unfavorable events happen together. The correlation risk drives potential losses to unexpected levels.

Another example of correlation risk lies with real estate loans secured by real property. Borrowers tend to default on loans (i.e., default rate risk) at the same time that the real property values fall (i.e., recovery rate risk—the creditor's collateral is worth less, thereby compromising the recovery rate on the funds lent to the borrowers). These two risks occurring simultaneously could also bring potential losses to unexpected levels.

The Relationship Between Risk and Reward

LO 1.d: Interpret the relationship between risk and reward, and explain how conflicts of interest can impact risk management.

As previously mentioned, there is a natural trade-off between risk and reward. In general, the greater the risk taken, the greater the potential reward. However, one must consider the variability of the potential reward. The portion of the variability that is measurable as a probability function could be thought of as risk (EL) whereas the portion that is not measurable could be thought of as uncertainty (unexpected loss).

For example, government bonds have less credit/default risk than corporate bonds. Therefore, government bonds will trade with lower yields than corporate bonds (all else equal). However, for a given maturity, the full relationship between risk and return goes further than merely credit risk (e.g., liquidity risks and taxation impacts may make the relationship less clear). Additionally, the risk tolerances (i.e., ability and willingness to take on certain risks) of market participants may change over time. When risk tolerances are high, the spread between riskless and risky bonds may narrow to an abnormally low level, which again disguises the true relationship between risk and return.

PROFESSOR'S NOTE

The risk/reward trade-off becomes much more complex to analyze for assets that are either thinly traded or not publicly traded. This is especially true for illiquid assets.

Because risk and reward are linked, it is very important for risk managers to properly consider relevant risks. As previously mentioned, a bank's EL could be modeled as the product of a borrower's PD, the bank's EAD, and the magnitude of the LGD. Risk managers could drill down on the PD to discern underlying loss drivers that need to be monitored. Some of the drivers could be the borrower's financial condition (e.g., sales growth trends, input cost trends, etc.) or it could be an external factor (e.g., weakening global trade or unfavorable tax policy changes). The potential list of loss drivers could be exhaustive. The advent of artificial intelligence and machine learning greatly enhances a risk manager's ability to consider and isolate economically important loss drivers to monitor.

In complex systems (e.g., financial markets), extreme unexpected losses (risk) sometimes occur. These tail risk events can be tragic for a risk management system. This is especially true when the correlation between risk factors increases. The triggers for lockstep movement between risk factors could be structural changes such as behavioral shifts, industry trends, government interventions, and new innovations. Danger arises when the frequency of tail events increases because the pace of structural uncertainty accelerates.

One of the biggest structural concerns is the potential for conflicts of interest. Those in the position to be most aware of the presence, probability, and potential impact of various risk factors are sometimes the ones who try to profit from its presence. This reality could be seen in the actions of rogue traders. It may also be seen from managers who conceal knowledge of a risk factor to maximize short-term stock price movements to enhance personal compensation through stock-based remuneration structures.

The best way to combat the potential for conflicts of interest to skew risk recognition is the following three-step process:

1. Risk recognition by frontline employees and division managers.
2. A robust risk management system with daily oversight.
3. Periodic independent audits to ensure that steps 1 and 2 are functioning properly.

MODULE QUIZ 1.1

1. Which of the following statements regarding risk and risk management is correct?
   - A. Risk management is more concerned with unexpected losses than expected losses.
   - B. There is a relationship between the amount of risk taken and the size of the potential loss.
   - C. The final step of the risk management process involves developing a risk mitigation strategy.
   - D. If executed properly, the risk management process may allow for risk elimination within an economy.
2. Which of the following items is not a building block of the risk management process?
   - A. Identifying relevant risk.
   - B. Measuring risks.
   - C. Avoiding all known risks.
   - D. Attempting to quantify any expected losses.
3. Examining the impact of a dramatic increase in interest rates on the value of a bond investment portfolio could be performed using which of the following tools?
   - I. Stress testing.
   - II. Enterprise risk management.
   - A. I only.

B. II only.
C. Both I and II.
D. Neither I nor II.

4. Which of the following items would be associated with unexpected losses?
   I. Loan defaults are increasing simultaneously while recovery rates are decreasing.
   II. Lending losses are covered by charging a spread between the cost of funds and the lending rate.
   A. I only.
   B. II only.
   C. Both I and II.
   D. Neither I nor II.
5. Which of the following statements is incorrect with respect to the relationship between risk factors?
   A. The risk/reward trade-off is easier to consider for individual stocks than for private equity investments.
   B. Risk management conflicts of interest can be easily mitigated through stock-based compensation.
   C. Risk managers should consider granular loss drivers.
   D. Risk management conflicts of interest can be mitigated through periodic internal audits.

MODULE 1.2: TYPES OF RISK

LO 1.e: Describe and differentiate between the key classes of risks, explain how each type of risk can arise, and assess the potential impact of each type of risk on an organization.

All firms face risks. These risks can be subcategorized as market risks, credit risks, liquidity risks, operational risks, legal and regulatory risks, business and strategic risks, and reputation risks.

Market Risk

Market risk refers to the fact that market prices and rates are continually in a state of change. The four key subtypes of market risk are interest rate risk, equity price risk, foreign exchange risk, and commodity price risk. The key to mitigating these risks is to understand the relationship between positions. As these relationships change, risk management methods need to change as well.

- **Interest rate risk** refers to uncertainty flowing from changes in interest rate levels. If market interest rates rise, the value of bonds will decrease. Another form of interest rate risk is the potential for change in the shape of (or a parallel shift in) the yield curve. Interest rate risk may arise from having positions that are either completely or partially unhedged. This occurs when underlying transactions do not fully offset. In this instance, the loss could be attributed to *basis risk*, which means that the presumed correlation between the price of a bond and the price of the hedging vehicle used to hedge that bond has changed unfavorably.
- **Equity price risk** refers to the volatility of stock prices. It can be broken up into two parts: (1) *general market risk*, which is the sensitivity of the price of a stock to changes

in broad market indices, and (2) *specific risk*, which is the sensitivity of the price of a stock due to company-specific factors (e.g., rising cost of inputs, strategic weaknesses, etc.). General market risk cannot be diversified away, while specific risk can be mitigated by holding assets with less than perfect correlations.

- **Foreign exchange risk** refers to monetary losses that arise from either fully or partially unhedged foreign currency positions. Foreign exchange risk results from imperfect correlations in currency price movements as well as changes in international interest rates. Potentially large losses could reduce an entity's competitive edge relative to its foreign competitors.
- **Commodity price risk** refers to the price volatility of commodities (e.g., precious metals, base metals, agricultural products, energy) due to the concentration of specific commodities in the hands of relatively few market participants. The resulting lack of trading liquidity tends to increase the amount of price volatility compared to financial securities. In addition, commodities may face significant price discontinuities (i.e., prices suddenly jump from one level to another).

Credit Risk

Credit risk refers to a loss suffered by a party whereby the counterparty fails to meet its contractual obligations. Credit risk may arise if there is an increasing risk of default by the counterparty throughout the duration of the contract. There are four subtypes of credit risk: (1) default risk, (2) bankruptcy risk, (3) downgrade risk, and (4) settlement risk.

- **Default risk** refers to potential nonpayment of interest and/or principal on a loan by the borrower. The PD is central to risk management.
- **Bankruptcy risk** is the chance that a counterparty will stop operating completely. The risk management concern is that the liquidation value of any collateral might be insufficient to recover a loss flowing from a default.
- **Downgrade risk** considers the decreased creditworthiness of a counterparty. A creditor may subsequently charge the downgraded entity a higher lending rate to compensate for the increased risk. For a creditor, downgrade risk may eventually lead to default risk.
- **Settlement risk** could be illustrated using a derivatives transaction between two counterparties. At the settlement date, one of them is in a net gain ("winning") position and the other is in a net loss ("losing") position. The position that is losing may simply refuse to pay and fulfill its obligations. This risk is also known as *counterparty risk* (or **Herstatt risk**[1]).

Consider an example where one investor's net gain on a futures contract is $500,000 at settlement. The counterparty must pay this amount, but they have encountered financial difficulty and are only able to pay $400,000. This estimated payment is called the **recovery value**, and the $100,000 that will be lost is known as the **loss given default (LGD)**. Expressed in percentages, the **recovery rate** is 80% and the LGD is 20%. If the recovery rate was 0%, then the counterparty would be in complete default and possibly in a bankruptcy scenario.

Risk managers use sophisticated modeling to properly consider credit risk. Following is a list of some very important considerations relative to this risk identification process:

- Is the interest rate charged on the instrument commensurate with the risk taken?
- Is a portfolio of instruments diversified both geographically and by industry?
- Have correlations between instruments and other known risk factors been properly considered?
- Are any firm-specific or industry-specific financial ratios indicating a cause for concern?
- Is a lender exposed to a large number of small loans or a small number of large loans? Concentration risk can be a real concern.
- What is the PD for the various instruments owned?
- Are the probabilities of default correlated in any way?

Liquidity Risk

Liquidity risk is subdivided into two parts: (1) funding liquidity risk and (2) market liquidity risk. If liquidity risk becomes systemic, it could lead to elevated credit risk (e.g., a potential default scenario).

- **Funding liquidity risk** occurs when an entity is unable to pay down (or refinance) its debt, satisfy cash obligations to counterparties, or fund capital withdrawals. This risk can be illustrated from the perspective of the banking industry, which has a natural mismatch between assets and liabilities (e.g., short-term deposits mismatched with longer-term loans). Improper risk management of this fundamental mismatch led to bank defaults during the financial crisis of 2007–2009.
- **Market liquidity risk** (also known as **trading liquidity risk**) refers to losses flowing from a temporary inability to find a needed counterparty. This risk can cripple an entity's ability to turn assets into cash at any reasonable price. Transactions with an element of immediacy might need to be consummated with a significant discount, which typically translates into a huge loss. The impact of market liquidity risk could include impairments in an entity's ability to control market risk and to cover any funding shortfalls.

Operational Risk

Operational risk refers to potential losses flowing from inadequate (or failed) internal processes, human error, or an external event.[2] The details of operational risk could relate to factors such as inadequate computer systems (*technology risk*), insufficient internal controls, incompetent management, fraud (e.g., losses due to intentional falsification of information), employee mistakes (e.g., losses due to incorrect data entry or accidental deletion of a file), natural disasters, cyber security risks, or rogue traders.

Within a financial institution, the leveraged nature of derivatives transactions makes them highly susceptible to operational risk. This is further amplified by the models used to price complex assets that may be less liquid than mark-to-market rules require. A very robust

system of internal controls is required within an entity. Otherwise, there is a risk of significant losses due to various operational risks, which can be challenging to quantify.

Legal and Regulatory Risk

Legal risk is the potential for litigation to create uncertainty for a firm. In the context of a two-way financial transaction, an example of legal risk is one party suing the other party in an attempt to terminate the transaction. **Regulatory risk** refers to uncertainty surrounding actions by a governmental entity. An example of regulatory risk could be a change in tax law or margin requirements that alter the payoff for a given trade. In practice, legal and regulatory risks are highly integrated with both operational and reputation risk (discussed shortly).

Business and Strategic Risk

Business risk refers to variability in inputs that influence either revenues (e.g., customer demand trends, product pricing policies, etc.) or cost structures (e.g., the cost of production inputs, supplier negotiations, etc.). Diverse business elements such as new product innovations, shipping delays, and production cost overruns could also be labeled as business risks.

Strategic risk involves long-term decision making about fundamental business strategy. These long-term strategic initiatives may involve large capital investments in either equipment or human capital. For example, an entity could spend millions of dollars developing a new product that ultimately fails in the marketplace because consumers find it unsuitable for their needs. Alternatively, the regulatory landscape could change and materially alter the profitability of a project. Another example of strategy risk is a bank that changes its lending standards to originate more loans only to find that the risk of the loans elevates to a disastrous level during a period of market distress.

Reputation Risk

Reputation risk is the danger that a firm will suffer a loss in public perception (or consumer acceptance) due to either: (1) a loss of confidence in the firm's financial soundness or (2) a perception of a lack of fair dealing with stakeholders. Reputation risk is often one of the outcomes of experiencing a loss in another risk category. For example, a significant credit risk experienced by a bank could create a reputational impact for the firm. Likewise, the exponential growth in technology (and the internet) could lead to operational risks such as a cyberattack. Social media can also amplify reputation risk as users can spread information quickly that may or may not be accurate. The impact of reputation risk on an entity could start with lost profits and eventually lead to insolvency as public perception of the entity diminishes together with the value of the entity.

Overall, an entity should clearly define its holistic appetite for assuming risk. The entity might decide to be very conservative in assuming credit risk, while behaving with an entrepreneurial spirit with respect to business risk. There is also a tremendous interconnection between the different types of risk. For example, a company might be exposed to currency risk because of a new innovation that requires either international sales or internationally-sourced production inputs.

Risk Factor Interactions

LO 1.f: Explain how risk factors can interact with each other and describe challenges in aggregating risk exposures.

A significant danger in risk management occurs when independent risk factors are correlated. For example, a granular factor that leads to default risk for a loan could ultimately spill over into credit risk, operational risk, business risk, and reputation risk. This is most dangerous with unexpected losses. Realizing the potential for correlation between risks will help a risk manager measure and manage unexpected losses with marginally more certainty. For example, a risk manager could consider historical correlations between identified risk factors and forecast the nature of these relationships to measure the risk planning process.

Another significant challenge for risk managers is understanding how **risk aggregation** can be applied to measure all risks at the enterprise level. To consider the potential for complexity, consider the difference between quantifying the market risk associated with an individual stock versus a derivatives transaction. Market risk for a stock can be modeled using past volatility and the notional amount at risk. However, derivatives can be considerably more complex. Their volatility can be significantly higher than that of an individual stock. Sometimes, exposures to multiple derivatives contracts can cancel each other out, which means that notional value would not even apply, although risk is still involved. Market participants have resorted to using option *Greeks* (e.g., delta, gamma, theta, and vega) to model uncertainty, but these values cannot be aggregated with other positions to the enterprise level.

VaR has emerged as a popular attempt at risk aggregation, but it has some drawbacks. First, there are a few different versions of VaR used in practice. Second, VaR uses several simplifying assumptions, and risk managers can alter the computed value by adjusting the number of days or the confidence level used in the calculation. Third (and perhaps the most important challenge), VaR is intended to determine a loss threshold level. It measures the largest loss at a specified cutoff point, not the magnitude of tail risk. For this reason, some risk managers (and regulators) have turned their attention to scenario analysis, stress testing, and **expected shortfall**, which is a statistical measure designed to estimate the magnitude of aggregate tail risk losses. The drawbacks of relying on VaR as a single risk metric were clearly discovered during the financial crisis of 2007–2009.

However, VaR is still a very valuable enterprise-level risk metric. One valuable use is to consider risk exposures across business units. The related measure of economic capital is also extremely useful for risk managers. It enables a conceptually simple method of considering risk, which involves calculating a **risk-adjusted return on capital (RAROC)**, shown as follows[3]:

RAROC = after-tax risk-adjusted expected return / economic capital

This formula is essentially reward per unit of risk, and the numerator needs to be adjusted for expected losses. The practical application of the RAROC formula involves comparing the calculated value to the cost of equity. Only reward-to-risk measures that exceed the cost of capital should be considered acceptable. Four specific practical applications are:

1. *Business comparison*. This metric permits comparison of business units even when different levels of economic capital exist for each segment.
2. *Investment analysis*. This approach could be used to evaluate potential new product offerings. For example, a bank could use this technique to decide whether to branch out into a new credit product.
3. *Pricing strategy*. Firms could use RAROC to determine if their current pricing strategy provides sufficient return relative to the estimated risk taken.
4. *Risk management*. In the most basic sense, this metric can be used to highlight areas where risk is not being properly covered with expected rewards.

The overall point of risk management is to consider the drivers of risk and whether sufficient reward is generated relative to the level of risk assumed. Risks can be avoided, retained, mitigated, or transferred. This is the heart of the risk management process.

MODULE QUIZ 1.2

1. In considering the major classes of risks, which risk would best describe an entity with weak internal controls that could easily be circumvented with a lack of segregation of duties?
   A. Business risk.
   B. Legal and regulatory risk.
   C. Operational risk.
   D. Strategic risk.
2. Local Bank, Inc., (LBI) has loaned funds to a private manufacturing company, named We Make It All (WMIA). The current balance of the loan is $1 million, and it is secured by a piece of land and the corresponding building owned by WMIA. Due to an economic downturn, WMIA suffered a loss for the first time in its 10-year operating history and is currently experiencing some cash flow difficulties. In addition, the land and building that is held as collateral has recently been appraised at only $800,000. Based only on the information provided, which of the following risks faced by LBI have increased?
   A. Bankruptcy risk and default risk.
   B. Bankruptcy risk and settlement risk.
   C. Default risk and downgrade risk.
   D. Default risk, downgrade risk, and settlement risk.
3. Which of the following statements is correct relative to risk aggregation?
   A. Enterprise-level risk should be reduced to a single number (e.g., value at risk) for ease.
   B. Expected shortfall provides a more complete understanding of the potential magnitude of losses.
   C. Risk aggregation is most straightforward for derivatives contracts.
   D. Measuring dispersion using the option Greeks can streamline the risk aggregation process.

KEY CONCEPTS

LO 1.a

Risk is uncertainty surrounding outcomes. A risk management process is a series of actions designed to reduce or eliminate the potential to incur loss. Risk taking refers to the active acceptance of incremental risk in the pursuit of incremental gains.

The risk management process is a formal series of actions designed to determine if the perceived reward justifies the expected risks.

There are several core building blocks in the risk management process, which are listed as follows:

1. Identify risks.
2. Measure and manage risks.
3. Distinguish between expected and unexpected risks.
4. Address the relationship between risks.
5. Develop a risk mitigation strategy.
6. Monitor the risk mitigation strategy and adjust as needed.

LO 1.b

Value at risk (VaR) and economic capital are two ways that risk managers can attempt to quantify risk. Some of the qualitative methods include scenario analysis and stress testing. Risk managers need to be careful to not think that enterprise-level risk can be reduced to a single number. Risk is a complex concept that requires a dynamic process to identify, measure, mitigate, and monitor relevant risks.

LO 1.c

Expected losses are the average loss expected over a given time horizon. They are a function of (1) the probability of a risk occurring; (2) the dollar exposure to the risk event; and (3) the expected severity of the loss if the risk event does occur. Unexpected losses are losses that exceed the average result expected. When unexpected losses are clustered (i.e., correlation risk) they can become a little easier to model.

LO 1.d

There is an observed trade-off between risk and reward; opportunities with lower risk also have lower risk potential. Risk managers need to consider not only the potential impact of a given risk but also the granular loss drivers that underpin a given risk. Sometimes corporate insider goals conflict with those of shareholders. This reality could drive risk taking that promotes an ulterior benefit that may later cause a big problem when an extreme unexpected loss (i.e., tail risk) materializes. Multiple layers of supervision along with periodic and independent internal audits can help to offset these conflicts of interest.

LO 1.e

The general term *risk* can be subcategorized as market risks, credit risks, liquidity risks, operational risks, legal and regulatory risks, business and strategic risks, and reputation risks.

- Market risk refer to potential losses resulting from changes in financial market levels or volatility.
- Credit risk is essentially the risk of default on a loan.
- Liquidity risk relates to not having access to enough money to meet business needs. This could also flow from an inability to quickly exchange a financial asset for a reasonable amount of cash.

- Operational risk is a very broad category that involves potential losses flowing from inadequate (or failed) internal processes, human error, or an external event.
- Legal and regulatory risks come from either the threat of litigation or the threat of unfavorable government actions.
- Business risk refers to variability in either revenue or input cost that influence the viability of the business.
- Strategic risk involves uncertainty surrounding long-term business strategy.
- Reputation risk is a loss of sales due to a decline in public perception about the company's products or general level of fairness.

LO 1.f

Some risks are correlated, which can lead to a domino effect where one risk leads directly to another risk. This can amplify risk exposures. Risk aggregation is the process of considering risk at the enterprise level. Higher complexity of the underlying risks will lead to less reliability of risk assumptions.

VaR and the associated economic capital measurement are both useful metrics that provide risk managers information. A risk-adjusted return on capital (RAROC) can be calculated for comparison purposes, but VaR should not be considered as a stand-alone risk metric because it makes certain assumptions, can be adjusted by input parameters, and there are different types of VaR measurements. However, VaR, economic capital, and RAROC can be useful for helping risk managers better understand the aggregate risk exposure of a firm.

ANSWER KEY FOR MODULE QUIZZES

Module Quiz 1.1

1. **A** Risk management is more concerned with the variability of losses, especially ones that could rise to unexpectedly high levels or ones that suddenly occur that were not anticipated (i.e., unexpected losses). Risk is not necessarily related to the size of the potential loss. For example, many potential losses are large but are quite predictable and can be accounted for using risk management techniques. The final step of the risk management process involves assessing performance and amending the risk mitigation strategy as needed. The risk management process only involves risk transferring by one party and risk assumption by another counterparty. It is a zero-sum game, so it does not result in overall risk elimination. (LO 1.a)

2. **C** Risk managers should identify relevant risks, measure them, determine how to manage the risks, distinguish between expected and unexpected risks, consider the relationship between risks, develop a risk mitigation strategy, and monitor the process. They do not need to avoid all risks, which is impossible, because carrying manageable risks is one path to potential reward. (LO 1.a)

3. **C** Examining the impact of a dramatic increase in interest rates is an example of stress testing. Enterprise risk management makes use of measures such as stress testing. (LO 1.b)

4. **A** Loan defaults are increasing simultaneously while recovery rates are decreasing is an example of correlation risk. Correlation risk could drive up the potential losses to unexpected levels. In contrast, if lending losses are covered with a spread, given that there is sufficient information to compute such a spread, then the losses would likely be considered expected losses. (LO 1.c)

5. **B** The risk/reward trade-off is easier to navigate for assets that are less complex. Individual stocks are considerably less complex than the thinly traded securities or illiquid assets that private equity investors embrace. Risk management conflicts are best mitigated through supervision (e.g., periodic independent internal audits). These conflicts generally are increased by the inclusion of stock-based compensation because risk managers might ignore certain risks to pursue the potential of personal financial gain in the short-term. Risk managers should always consider granular loss drivers to better understand what could impact the risk/reward trade-off. (LO 1.d)

Module Quiz 1.2

1. **C** Weak internal controls and lack of segregation of duties would represent a nonfinancial risk and be best described as an operational risk. Business risk focuses on the income statement (i.e., revenues too low and expenses too high). Legal and regulatory risk focuses on the risk of an entity being sued or the risk of unfavorable changes in the rules and laws that the entity must follow. Strategic risk focuses on significant new business investments or significant changes in an entity's business strategy. (LO 1.e)

2. **A** The fact that the loan is secured by land and the building is now worth less than the amount of the loan outstanding subjects LBI to increased *bankruptcy risk* in the sense that the liquidation value of the collateral is insufficient to recover the loss if the loan defaults. The financial loss and the cash flow difficulties suggest that there is increased *default risk* for LBI as well. *Downgrade risk* does not apply here because WMIA's loan is not publicly traded and is unlikely to be rated by a recognized rating agency. *Settlement risk* does not apply here either, because there is no exchange of cash flows at the end of the transaction that would be required to incur such risk. In this case, the loan is settled when WMIA fully repays the principal balance owed. (LO 1.e)

3. **B** By itself, VaR has flaws as a single risk score for a firm. It uses various assumptions and it can be managed by adjusting the confidence level. While VaR tells analysts the loss threshold, expected shortfall communicates the magnitude of losses beyond the VaR threshold. The use of derivatives can make risk aggregation more challenging because option Greeks (e.g., delta, gamma, theta, and vega) cannot be aggregated and some derivatives exposures cancel each other out, which means that notional value is not a good measure of the true risk exposure. (LO 1.f)

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[1] The term *Herstatt risk* refers to the counterparty risk associated with the failure of Herstatt Bank in Germany. The bank was closed by regulators in 1974 in the wake of a foreign exchange issue, and the bank's closure led to settlement risk with every counterparty of the bank.

[2] https://www.bis.org/publ/bcbs195.pdf, page 3, footnote 5.

[3] Crouhy, M., Galai, D., and Mark, R. *The Essentials of Risk Management, 2nd Edition (Chapter 17).* McGraw Hill, 2014.

The following is a review of the Foundations of Risk Management principles designed to address the learning objectives set forth by GARP®. Cross-reference to GARP FRM Part I Foundations of Risk Management, Chapter 2.

Reading 2

HOW DO FIRMS MANAGE FINANCIAL RISK?

Study Session 1

EXAM FOCUS

This reading builds on the material from the previous reading and provides coverage of additional fundamental risk management concepts. As a firm considers its risk management process, they need to clearly define the internal goal of this process. Additionally, they need to understand how much risk they wish to retain, avoid, mitigate, or transfer. Risk mapping helps a firm understand and prioritize which risks are most important internally. Only after risk mapping has been conducted can the desired mitigation tools be selected, deployed, and monitored. Risk management is an iterative process in that once risks are located and desired, mitigation methods are discussed, and risk managers need to reassess if the risk-generating business is the right strategic placement for the firm. For the exam, pay close attention to the material on managing risk exposures, hedging risk exposures, foreign currency risk, and the potential impact of risk management tools.

MODULE 2.1: CORPORATE RISK MANAGEMENT

Strategies for Risk Management

LO 2.a: Compare different strategies a firm can use to manage its risk exposures and explain situations in which a firm would want to use each strategy.

At a high level, a firm can pick from four different risk management strategies. Senior management and the board of directors are ultimately responsible for strategy selection, but risk managers can help inform the decision-making process. The risk management strategies are as follows:

1. Accept the risk.
2. Avoid the risk.
3. Mitigate the risk.
4. Transfer the risk.

A firm could decide to *accept* (i.e., retain) known risks. One reason to retain a risk is that it is perceived to have a small impact on the firm and managing the risk might prove more costly

than it is worth. Another reason to retain risk is that the investors/owners desire exposure to this risk factor. For example, owners of a gold mine may want direct exposure to the market price movements of gold. A third reason to potentially retain a risk is because the cost can be priced into the firm's products and passed along to customers. In this way, the firm is not negatively impacted by retaining the risk.

Sometimes the best strategy is to *avoid* risk all together. If a business risk is not a natural part of normal business operation, then it should be considered as a possible risk to avoid. This might mean completely stopping activity in a business unit if its risk is unnecessary for the overall function of the business. For example, some businesses retain operating units with very unconnected purposes. Conglomerates, like General Electric, are great examples of this notion. During the financial crisis of 2007–2009, their financial services business unit caused tremendous pain for the organization, which is fundamentally an industrial firm. Management realized that financial risks (and a few other business units) needed to be sold to avoid risks to their core business units.

Businesses that choose to retain risks may seek ways to strategically *mitigate* known risks. Mitigation can take many different forms depending on the risk factor involved. A bank may mitigate credit risk by offering loans at higher interest rates, with shorter maturities, and/or with enhanced collateral requirements. Manufacturers might mitigate rising labor costs by investing in automation, and transportation companies might mitigate rising fuel costs by upgrading planes, trucks, and/or other vehicles to more fuel-efficient versions.

Risk can also be *transferred* to a third party. This option can be costly because it usually involves either purchasing insurance coverage or investing in derivatives. Transferring risk also introduces *counterparty risk* because the firm is relying on the third party to make good on the insurance provided if a risk event arises.

In a rational process, the ultimate decision should be made after a thorough cost-benefit analysis. For example, a firm might conduct a worst-case scenario analysis and calculate their risk of a cyber threat to cost $75 million. If this cost is related to their core business, then they cannot avoid the risk, so they must decide how to adequately retain it. The next step is to assess the cost of insurance relative to the costs of mitigation through purchasing new equipment. The method with the best cost-benefit relationship should be strongly considered by senior management. In this example, the solution may be a mix of mitigation and risk transference.

Risk Appetite Relative to Risk Decision-Making

LO 2.b: Explain the relationship between risk appetite and a firm's risk management decisions.

With an awareness of the high-level strategies available, risk managers can proceed through a five-step risk management process. This section will focus on the first two items, while the others will be discussed in subsequent sections. The risk management process is as follows:

1. Identify risk appetite.
2. Map known risks.
3. Operationalize the risk appetite.

4. Implement a plan.
5. Monitor and adjust the plan as needed.

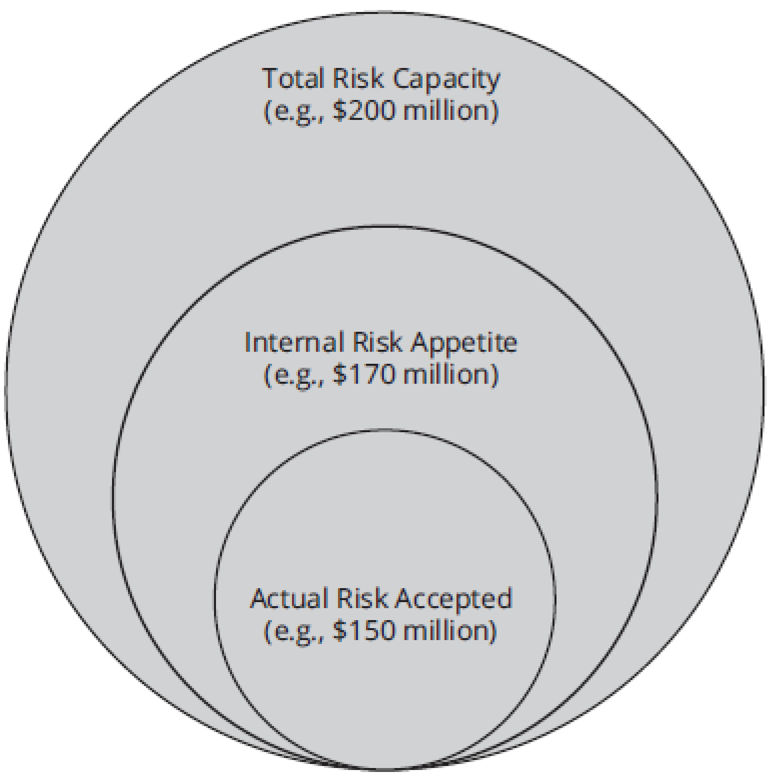
Risk appetite refers to the level (and types) of risk that a firm is willing to retain. There are two very important subcomponents: risk willingness and risk ability. *Risk willingness* relates to a firm's desire to accept risk in pursuit of its business goals, while *risk ability* can put a cap on risk willingness for various reasons. The most common reasons for reduced risk ability are internal risk controls (to keep risk in a desired range) and regulatory constraints. For example, banks are not permitted to have a leverage ratio (percentage of Tier 1 capital to bank assets) below 3%.

PROFESSOR'S NOTE

It is important to distinguish between a company's risk appetite and industry-level risk appetites as reported by popular media outlets. The latter is a general measure of sentiment, while the former is a more static internal control established by the senior leadership of a given company.

Actual risk levels should be set below the maximum capacity of a company. There is always the potential for error in the risk estimation process. If a firm has total risk capacity of $200 million and senior management has set a risk appetite at a lesser amount (e.g., $170 million), then managers should leave a margin for error and accept some risk level that is marginally below that amount (e.g., perhaps a cap of $150 million of exposure in this example). Figure 2.1 illustrates this concept.

Figure 2.1: Illustration of Accepted Risk Relative to Risk Capacity



Role of the Board of Directors

Senior management and the board of directors need to clearly define the firm's risk appetite and communicate the policy to stakeholders in a quantitative and/or qualitative manner.

There are several possibilities, including

- explicitly stating (qualitatively) which risks the firm wants to retain (i.e., leave risks unhedged) and, which risks to either avoid, mitigate, or transfer (i.e., either avoid or hedge the risk);
- using a quantitative metric such as value at risk (VaR) to convey the maximum loss the firm will tolerate for a given confidence level for a given period of time; and
- using stress testing whereby management considers possible but very severely negative scenarios to determine the level of losses. The results of stress testing can be used to inform the decision to retain, avoid, mitigate, or transfer known risks.

A problematic issue for the board of directors in determining the firm's risk appetite centers on the potential conflict between the two major stakeholders—debtholders and shareholders. Debtholders would likely be more concerned with minimizing all risks because their upside potential is generally limited to the rate of interest charged. In contrast, shareholders may be willing for the firm to accept a large but unlikely risk to increase equity returns.

The board must ensure that its goals are stated in a clear and actionable manner. This communication usually takes two forms. The first is a broad statement of risk appetite that can be used in external communications. The second is a very detailed statement that can be used internally so that risk managers and line managers understand the enterprise-level expectations. The detailed statement will be used to guide business decision-making, inform business planning cycles, and identify trouble spots where mitigation needs to be highlighted.

PROFESSOR'S NOTE

In their 2016 Annual Report, HSBC listed 13 broad risk categories of interest including earnings, credit risk, operational risk, market (traded) risk, regulatory risk, and financial crimes risk.

There are several complexities that the board may need to consider, depending on the unique circumstances of each firm:

1. *Unity of risk appetite*. Do the different risk types (i.e., market risk, credit risk, liquidity risk, operational risk, legal and regulatory risk, business and strategic risk, and reputation risk) have different risk appetites?
2. *Entrepreneurial opportunities*. Is there a type of risk that could provide a competitive edge if more risk is assumed than in other categories?
3. *Layers of correlated risks*. Does an operating unit expose the enterprise to more than one type of risk in which the risks might be highly correlated (e.g., operations of a foreign subsidiary could have operational and foreign currency risk that move in lockstep)? The company may need to pick which risks to hedge and which to accept.
4. *Time horizon*. Does the board prefer to focus on hedging short-term or long-term risks because they may be mutually exclusive? Often, companies may default to smoothing operations over time to support their stock price. Additionally, paying to hedge future-oriented risks could create short-term profitability issues due to the cash outlays involved.

5. *Possibility for risk limit tolerance bands*. Are there adequately communicated tolerance bands within which managers can operate? This will provide managers with some opportunistic flexibility while also clearly communicating expectations.
6. *Reputational impact*. What does the firm's risk appetite communicate to its stakeholders?
7. *Risk measurement*. How will risk be measured at the enterprise level? In Reading 1, it was established that it is difficult to reduce risk management to a single value at the firm-level. VaR, notional limits, and stress testing all have value, but a firm will need to logically deduce a metric that makes sense given their unique business model.

Risk Mapping

After a firm establishes its risk appetite, it should assemble an inventory of all known risks. This process is called **risk mapping** and it is the next logical step in the risk management process. This robust approach systematically considers any risk with a known (or potential) cash impact on the firm. Every type of risk (i.e., market risk, credit risk, liquidity risk, operational risk, legal and regulatory risk, business and strategic risk, and reputation risk) is considered. Risk managers should incorporate any known interactions between risk factors in terms of correlation risk or the possibility that one risk might cancel out the cash impact of another risk (i.e., there might be a risk netting that occurs).

Consider an example of a firm that has a known commodity risk exposure in its manufacturing process. Perhaps they are exposed to the price of copper. Futures contracts are readily available for copper, but more detail is required. What is the magnitude of the exposure? Does the firm need 1 million pounds of copper or do they need 10 million pounds? What is the timing of the need? Does the firm need all of the copper at one specific date or do they need 10% of the total amount at 10 different dates? Where do they need the copper? Does the firm need all of the copper in one geographical location or do they need it in five different regions/countries at different production facilities? The depth of these questions borders on supply chain queries, but risk managers need very granular information such as the magnitude of a need, the timing of a need, and the location of a need to properly create a risk map at the enterprise level.

Consider another example of a company with foreign sales. They sell products in 12 different countries (representing eight different currencies due to the euro being shared between a few customers). This company has foreign currency risk and possibly others as well. They need to figure out if they want to consider only current sales, current sales plus estimated sales that have a high probability of occurring, or some other variant. This consideration is in addition to the need to know the size, timing, and exact currency of the exposure. There is some netting potential with foreign currency risk because the firm may need to retain some of the foreign currency for operational needs. All of these details are needed in the risk mapping process.

The robustness of the risk mapping process will directly correlate with the level of granularity of the inputs. It has been illustrated that businesses need to consider the magnitude of the exposures, the timing of the exposures, the location of the exposures, the calculation methodology (i.e., current or projected values), and the potential for risk netting. At a minimum, this granular process should be conducted for the top-10 risk exposures for a

firm, but it is best to do this exercise for all known risks if possible. The ultimate goal is to understand the risk landscape for a firm, which will enable senior managers to determine which risks to retain, avoid, mitigate, or transfer.

Hedging Risk Exposures

LO 2.c: Evaluate some advantages and disadvantages of hedging risk exposures, and explain challenges that can arise when implementing a hedging strategy.

There are many risks that can be hedged but not all should be hedged. Some investors would prefer that risks remain unhedged because they are looking for the specific risk exposure provided by a given company (e.g., commodity or currency exposure). The primary goals of hedging risks are to increase financial stability and reduce the risk of financial distress (e.g., bankruptcy or reputational risks). There are several practical advantages of hedging to consider, as well as some theoretical and practical disadvantages.

Hedging Advantages (In Practice)

One of the key reasons for a firm to hedge its risk exposures is the possibility of lowering its cost of capital (either debt or equity), which could lead to increased economic growth. A firm may also be able to increase its debt capacity by reducing the volatility of its earnings/cash flows. This would potentially provide access to lucrative investment opportunities. Additionally, borrowing arrangements for firms with less volatile earnings/cash flows usually contain fewer conditions and restrictions imposed by the lenders.

There is also a potential cash flow advantage. The firm may engage in hedging activity that extends beyond risk transfer to involve cash flow enhancement. For example, a company may begin with an effort to hedge commodity prices and end up with a large profit position in futures contracts. Another possible cash flow impact could occur if the hedging activities smooth out revenues/costs, such that tax liabilities decrease. This occurrence would have a direct cash flow impact by paying less money to taxing authorities.

There is a signaling element of hedging. Stability in a firm’s operations signals strength to its stakeholders. This reputational message could impact lenders, customers, suppliers, and employees. This stability is often directly reflected in the firm’s stock price. The other signaling aspect of hedging is that it communicates the risk appetite established by the firm’s board of directors.

Management may see hedging as having two other distinct benefits. First, it makes business planning easier because the risks are controlled. Second, it enables managers to potentially lock-in strong margins, which in turn may affect both their prestige and compensation. Hedging can be used as a crutch to meet short-term performance goals; however, it also enables the advantage of locking in solid performance when it organically exists.

Hedging with derivatives instruments such as swaps (and options) may be cheaper than purchasing an insurance policy. One must consider whether the total cost of the insurance over the years exceeds the estimated losses.

Hedging Disadvantages (In Theory)

In 1958, Franco Modigliani and Merton Miller argued that under the assumption of perfectly competitive capital markets with no transaction costs or taxes, both the firm and the individual investor are able to perform the same financial transactions at the same cost. In other words, the value of the firm will not change despite any attempt to hedge risk exposures. Unfortunately, the assumption of no transaction costs or taxes is highly unrealistic in the real world, which makes it a weak argument not to hedge risk.

In 1964, William Sharpe developed the capital asset pricing model (CAPM), which argues that under perfect capital markets, firms should only be concerned with systematic risk (or beta risk; risk that is common to all market participants). Firms should not be concerned with unsystematic risk (or idiosyncratic risk) that pertains specifically to the firm, because such risk could be reduced through diversification in a large investment portfolio in a costless manner. Unfortunately, the perfect capital markets assumption is not realistic in practice, and diversification activities will result in transaction costs.

There is the belief by many market participants that hedging is a zero-sum game that has no long-term increase on a firm's earnings or cash flows (because earnings/cash flows are simply moved between periods). That argument assumes perfect capital markets and that derivatives pricing fully reflects all of its risk factors. Unfortunately, in practice, derivatives pricing is extremely complex and not as accurate as equity and bond pricing. Therefore, derivatives pricing is not always likely to reflect all of its risk factors; therefore, hedging with derivatives may not always be a zero-sum game of transferring risk between periods or between participants.

A noteworthy point is that none of the arguments just listed consider the existence of the significant costs of financial distress and bankruptcy, a point that runs contrary to the assumption of perfect capital markets.

Hedging Disadvantages (In Practice)

Hedging activities may introduce disadvantages in the form of unplanned costs. One potential hidden cost is that hedging may cause management to lose focus on the core business activities of the firm. Misplaced focus could result in lost profit opportunities. Another potential cost involves compliance expenses (e.g., disclosure, auditing, and monitoring costs).

Another disadvantage is the inherent complexity involved with derivatives contracts. Leverage built into many derivatives contracts can add complexity to analyzing the assumed risks. The use of derivatives could shift the company into unintended risk exposures. For example, a firm might hedge interest rate risks through a swap contract that may introduce unplanned downside risk. Relatedly, hedging may adjust payment structures by exchanging short-term payments for a balloon payment that shifts (and potentially amplifies) risk exposures. Also, the use of derivatives may reveal operational information that a firm may otherwise prefer to keep private. Such costs could reduce the firm's incentive to hedge its risks.

The complexity of derivatives pricing means the pricing may not always be as accurate as possible, so it will not always reflect all of the relevant risk factors. As a result, in practice,

hedging with derivatives may not be a *zero-sum game* of transferring risk between periods or between participants.

Challenges Involved With Hedging Strategies

One potential challenge of hedging is that the firm might misunderstand its risk exposures during the risk mapping process. Selecting the wrong risks, missing relevant risks, or misestimating risks could result in notional values on derivatives that are either too high or too small. They could also mean that risks (e.g., a specific currency risk) remains unhedged during a period when it could create a substantial risk event.

Another challenge is that market trends change. Commodity prices, foreign exchange rates, and interest rates (among other risk variables) are very dynamic. When these variables change, risk exposures also change, and the risk management process needs to be as dynamic as the risk variables themselves. The challenge is that the pace of change may be too burdensome for some firms to actively manage. Attempting to hedge using a flawed hedging strategy may result in losses to the firm that are greater than the actual risks.

There is also the potential for problems to be amplified by poor communication. The concern relates to strategy that has not been effectively communicated and to potential consequences that are not adequately disseminated to decision makers. The implosion of MG Refining and Marketing (MGRM) in 1993 is a classic example of poor communication. They were the American subsidiary of Metallgesellschaft AG, and they had agreements with customer to deliver 150 million barrels of gasoline and heating oil spanning over 10 years. Management chose to hedge their risk using rolling short-dated futures and over-the-counter (OTC) swaps. Changes in the oil market generated significant margin calls, which caused MGRM's parent company to close all hedging positions and lock-in large losses. Subsequently, the oil markets reversed and moved against MGRM's position and created a second wave of losses on their now unhedged exposures. These substantial losses may have been prevented had management more effectively communicated their strategy and the parent company bought into the notion.

One challenge, that is somewhat easily fixable, is that hedging often requires very specific skills, knowledge, research, and time. The company may not have the necessary human capital internally. Fortunately, this challenge can potentially be remediated by outsourcing the hedging duties to a trusted third party risk manager.

One way to combat this series of challenges is to build a strong internal risk culture in which employees are aware of company goals and working toward accomplishing them. This culture does not develop by accident. A few suggestions to create such a culture are the following:

1. Regularly communicate risk goals and potential warning signs when risk limits are about to be breached.
2. Conduct training to ensure that key staff have a unified understanding of risk management goals.
3. Key staff should understand the potential consequences if risk limits are breached.
4. The board of directors should be able to articulate the firm's top-10 risks.

MODULE QUIZ 2.1

1. Bank Y has decided to use currency futures and forward to offset its entire estimated foreign sales exposure. Which high-level risk mitigation strategy does this description represent?
   A. Retain risk.
   B. Avoid risk.
   C. Mitigate risk.
   D. Transfer risk.
2. The involvement of the board of directors is important within the context of a firm's decision to hedge specific risk factors. Which of the following statements regarding the setting of risk appetite is correct?
   I. Risk appetite may be conveyed strictly in a qualitative manner.
   II. Debtholders and shareholders are both likely to desire minimizing the firm's risk appetite.
   A. I only.
   B. II only.
   C. Both I and II.
   D. Neither I nor II.
3. Melody Li is a junior risk analyst who recently prepared a report on the advantages and disadvantages of hedging risk exposures. An excerpt from her report contains four statements. Which of Li's statements is correct?
   A. "Purchasing an insurance policy is an example of hedging."
   B. "In practice, hedging with derivatives may not be a zero-sum game."
   C. "The existence of significant costs of financial distress and bankruptcy is a natural consideration by perfect capital markets."
   D. "Hedging with derivatives is advantageous in the sense that there is often the ability to avoid numerous disclosure requirements compared with other financial instruments."

MODULE 2.2: RISK MANAGEMENT METHODS AND INSTRUMENTS

Hedging Operational and Financial Risks

LO 2.d: Apply appropriate methods to hedge operational and financial risks, including pricing, foreign currency, and interest rate risk.

Hedging operational risk covers a firm's activities in production and sales (i.e., expenses and revenue). These operational risks can be considered as income statement risks. However, financial risk relates to a firm's balance sheet (i.e., assets and liabilities). By making the realistic assumption that there are some imperfections in the financial markets, a firm could benefit from hedging financial risk. Hedging activities should cover both the firm's assets and liabilities to fully account for the risks.

Pricing Risk

The cost of inputs may have a significant impact on the firm's ability to conduct its business in a competitive manner. Therefore, it makes sense to hedge such pricing risk by purchasing a forward or futures contract to buy a specific quantity of that input at a fixed cost, which

can be determined in advance. The same advanced planning can benefit a firm's domestic or foreign sales, as will be discussed next.

Foreign Currency Risk

The goal of hedging foreign currency risk is to control exposure to exchange rate fluctuations that impact both future cash flows (revenue) and the fair value of assets and liabilities.

Revenue hedging can be used when a firm has sales to customers in foreign countries (with payment in the foreign currency). The concern is that losses will result when foreign sales are repatriated into the firm's domestic (home) currency. The firm could hedge some of its expected foreign currency receipts. They should factor both the cost of hedging as well as revenue and exchange rate volatilities and correlations. Instruments that could be used include currency put options (to ensure a known absolute minimum return should the exchange rate fall beyond the strike rate) and forward contracts (to ensure a known return based on an exchange rate determined in advance and acceptable to the firm).

In hedging the firm's balance sheet exposures, the focus is on the impact of foreign exchange rate fluctuations on the net monetary assets of its foreign investments. Forward contracts are often used in this regard because they allow for the payment (loss) or receipt (gain) by the firm of a fixed amount at a fixed exchange rate that would offset any impact of rate changes on the net monetary assets (gain or loss; opposite of the forward contract). Foreign currency debt (liability) could also serve as a natural offset against a decrease in the value of a firm's foreign investment (asset). Note that in some instances hedging is cost prohibitive, so some foreign currency positions may be left deliberately unhedged.

Interest Rate Risk

The goal of hedging interest rate risk is to control the firm's net exposure (asset or liability) to unfavorable interest rate fluctuations. From both an investing and a borrowing perspective, interest rate swaps (or swaptions) may be used to protect a firm against losses. Also, it may help a firm to minimize its borrowing costs. Identical to the previous point about high hedging costs, some interest rate positions may be left deliberately unhedged.

Static and Dynamic Hedging Strategies

A **static hedging strategy** is a simple process in which the risky investment position is initially determined, and an appropriate hedging vehicle is used to match that position as closely as possible (minimize basis risk). In contrast, a **dynamic hedging strategy** is a more complex process that recognizes that the attributes of the underlying risky position may change with time. Assuming it is desired to maintain the initial risky position, there will be additional transaction costs required to do so. Significantly more time and monitoring efforts are required with a dynamic hedging strategy.

Additional hedging considerations include the following:

- The firm must consider relevant time horizons for hedging and ensure that performance evaluations are matched with the time horizons.

- The firm needs to assess the (often) complex financial accounting implications of hedging with derivatives. For example, if the hedge is not an exact match or offset to the underlying position, then there will be a gain/loss to report on the income statement.
- The taxation of derivatives is a key issue because of its impact on the firm's cash flows as well as the differing laws between countries. Significant effort and cost (which increase hedging cost) may be required to decipher the complex tax rules surrounding derivatives.

The Impact of Risk Management Tools

LO 2.e: Assess the impact of risk management tools and instruments, including risk limits and derivatives.

A firm needs to decide if its hedging strategy is a one-off event or if it is part of broader risk management need. This decision is sometimes referred to as *rightsizing* a risk management program. The financial markets are very dynamic, and a broadly-applied risk management strategy requires investment in complex systems and hiring experienced traders. There are several risk limits that need to be understood and potentially controlled depending on the results of the risk mapping process. Figure 2.2 lists the various risk limits along with the purpose of each limit and potential weaknesses of focusing on that risk limit.

Figure 2.2: Risk Limits

Limit	Purpose	Potential Weaknesses
Stop Loss Limits	Sets a loss threshold which limits losses from escalating beyond a stop limit price.	Does not address the potential for future losses; only focuses on prevention of realizing a current loss.
Notional Limits	Sets notional exposure parameters.	The notional amount may not be strongly related to the actual risk assumed.
Risk Specific Limits	Targets a very specific risk (e.g., liquidity risk or currency risk).	Difficult to aggregate at the enterprise level and may require hiring someone with very specific skills.
Maturity/Gap Limits	Minimizes the amount of transactions that mature in any given period.	While this limit does smooth out operational risks relative to maturity events, it does not address price risk.
Concentration Limits	Imposes tolerance levels for concentration exposures (e.g., counterparty concentration or product type concentration).	Does not directly address the potential for correlation risk. Outcomes may be correlated even if they are not concentrated.
Greek Limits	Refers to option-specific limits relative to delta, gamma, theta, or vega.	Prone to model risk and estimation errors.
Value at Risk (VaR)	Attempt at an aggregated risk threshold.	Does not provide a measure of magnitude beyond the threshold. Subject to model risk, and input variables can be adjusted to yield desired results.
Stress Testing or Scenario Analysis	Consider implications of risk at specific stress points and combinations of multiple stress points. The idea is to test realistic worst-case scenarios.	Require varying levels of sophistication and intimate understanding of internal exposures. Difficult to know if all risk exposures have been covered in this process.

As a firm considers which risk management tools to utilize, it needs to adequately understand the goal of its risk management program. Many firms treat risk management as a cost center, in which the goal is to minimize negative effects on the firm. They need to specify if the physical costs of deploying risk management tools will be allocated to the division level or if they will be recorded at the enterprise level. It is also possible that a firm treats its risk management efforts as a potential profit center, in which the goal is to use various tools to add value to shareholders through a direct net income contribution.

Available risk management tools, known as derivatives contracts, are listed below. Some of these tools are exchange-traded derivatives and some are direct transactions between two

counterparties on the over-the-counter (OTC) markets.

1. **Forward contracts**. This is an OTC product that involves a transaction directly between two counterparties. The terms of the contract can be completely customized. Settlement may either be in cash or a physical item (e.g., barrels of oil).
2. **Futures contracts**. This is an exchange-traded product that is standardized in its terms and conditions (i.e., no customization as with a forward contract). They are similar to a forward contract except that a futures contract uses a financial intermediary (middle man that reduces counterparty risk) as a clearing agent to facilitate the transaction.
3. **Swap contracts**. This is a customizable OTC product in which two parties agree to swap economic positions. For example, an interest rate swap could be structured for one party to pay a fixed interest rate and receive a variable rate from the counterparty.
4. **Call option contracts**. The buyer of a call option has the right (not the obligation) to *buy* shares of an underlying security (e.g., shares of stock or an index) at a specified (strike) price either at the maturity date (European options) or before the maturity date (American options).
5. **Put option contracts**. The buyer of a put option has the right (not the obligation) to *sell* shares of an underlying security (e.g., shares of stock or an index) at a specified (strike) price either at the maturity date (European options) or before the maturity date (American options).
6. **Exotic option contracts**. There are many complex options in the global marketplace that provide call- and/or put-like features with different twists, like Asian options that use average pricing.
7. **Swaption contracts**. Much like an option contract, a swaption provides the swaption buyer the right (not the obligation) to enter a swap contract at some future date but with terms established when the swaption is initiated.

PROFESSOR'S NOTE

These derivatives instruments will be discussed in much more detail in Book 3.

Derivatives contracts have different benefits/drawbacks, depending on their trading location. Exchange-traded derivatives are attractive to investors seeking liquidity, low transaction costs, and reduced counterparty risk (because they are cleared through an exchange rather than independent parties). The catch is that they are standardized and there may not be an exact match to a risk manager's need in terms of underlying security, timing, or location of delivery. This mismatch is sometimes called **basis risk**. On the other hand, derivatives contracts that are issued through OTC channels can be highly customized, but they sometimes lack liquidity, are more expensive, and they contain meaningful levels of counterparty risk. An OTC contract could be structured to meet the exact need of a business, but risk managers will assume the risk that the counterparty might not make good on their end of the contract (counterparty and settlement risks).

Consider an example using the airline industry, which is heavily exposed to jet fuel prices. They need as much stability as possible because industry competition is such that they cannot pass along jet fuel price volatility to direct customers. There is not an exchange-

traded product for jet fuel, so airlines could consider using products linked to crude oil. This presents basis risk for the airlines and requires them to also manage the spread between crude oil and jet fuel. Most carriers prefer to use OTC products that can be targeted to jet fuel, but this does present counterparty risk. Delta Airlines tried a different approach using vertical integration. They bought an oil refinery, which allowed them to control jet fuel prices, but opened them up to the other risks inherent in oil refining. Risk managers will need to balance the benefits and drawbacks to select the best combination of risks and risk reducers for a given need.

MODULE QUIZ 2.2

1. Jasmine Cellars is a U.S. wine producer that purchases a significant amount of cork (from Asia) for its wine bottles. Eighty percent of their sales are to customers in North America. Based on these two broad transactions, which of the following risks does Cellars most likely face?
   A. Financial position risk and operational risk.
   B. Operational risk and pricing risk.
   C. Pricing risk only.
   D. Financial position risk, operational risk, and pricing risk.
2. You have just been hired as the vice president of risk management at Johnson Controllers. Your new employer is domiciled in the United States, but 35% of their sales are in Brazil. The highest priority task is to hedge the firm's exposure to the Brazilian real (their currency). You want to use a product that minimizes basis risk and can accommodate the firm's dynamic and sometimes unique cash flow patterns. Which tool would you least likely recommend?
   A. Futures contracts.
   B. Forward contracts.
   C. Swap contracts.
   D. Call option contracts.

KEY CONCEPTS

LO 2.a

Firms can pick from four different risk management strategies:

1. Accept the risk.
2. Avoid the risk.
3. Mitigate the risk.
4. Transfer the risk.

Risk acceptance could be done to actively include a risk factor in company performance or because the risk is being passed through to customers. Risk could also be avoided. If risk is retained, then it may be desirable to mitigate it through deal enhancement (i.e., more collateral on a loan or investing in new technology to offset a known risk). Risk can also be transferred to a third party, but this introduces counterparty risk into the equation.

LO 2.b

A firm's risk appetite is its willingness to retain risk. It is usually influenced by everyone from line managers right on up to senior managers. The company will map known risks and determine their potential magnitude, timing, and location. Once the risks have been mapped,

senior managers and the board of directors can establish enterprise-level risk tolerance levels, which will need to be monitored and periodically reassessed.

LO 2.c

Some of the benefits of deploying a hedging strategy include reduced costs, smoother operating performance, enhanced business planning, and the ability to lock-in positive results in the short-term. Some of the disadvantages include the potential for managerial focus to be shifted away from core operations, compliance costs, the possibility that new risks might be introduced in an attempt to minimize other risks, and the high level of complexity associated with many hedging strategies. Common challenges in the risk management process include misunderstanding or mis-mapping risk exposures, managing changes with risk variables in dynamic markets, and internal communication breakdowns.

LO 2.d

Hedging operational risks attempts to insulate revenues and expenses from unplanned risk. These could involve the cost of inputs or the currency impact on domestic performance. Financial risk refers to balance sheet items like assets and liabilities. Controlling these risks may involve interest rate hedging, among other factors. Companies will need to decide if they plan to hedge their operational and financial risks in a static (single hedge) or dynamic manner.

LO 2.e

A risk management process should be rightsized by determining which limits to impose and which risks to retain. Derivatives instruments could be used to physically manage risk, including: forward contracts, futures contracts, swap contracts, call option contracts, put option contracts, exotic option contracts, and swaption contracts. It is very important that a firm understand the benefits and drawbacks associated with their risk management tools relative to the status as either exchange-traded or OTC.

ANSWER KEY FOR MODULE QUIZZES

Module Quiz 2.1

1. **D** Since Bank Y has decided to take a formal action, they have not chosen to either retain or avoid the risk. Mitigation would involve taking some internal action without using a financial asset. In using futures and forward contracts, Bank Y has chosen to transfer their foreign currency risk to a third party. (LO 2.a)

2. **A** Risk appetite may be conveyed in a qualitative and/or quantitative manner, therefore, qualitative alone may be acceptable. Debtholders would likely be more concerned about minimizing all risks because their upside potential is generally limited to the rate of interest charged. In contrast, shareholders may be willing for the firm to accept a large but unlikely risk to increase equity prices. (LO 2.b)

3. **B** The complexity of derivatives pricing means that the pricing may not always be as accurate as possible, so it will not always reflect all of the relevant risk factors. As a result, in practice, hedging with derivatives may not be a zero-sum game of transferring risk between periods or between participants. Hedging involves the use of

financial derivatives, and insuring involves the use of insurance policies; an insurance policy is not considered a financial instrument in the same sense as a derivatives instrument. The existence of significant costs of financial distress and bankruptcy is contrary to the assumption of perfect capital markets. Hedging with derivatives will require disclosure, including some operational information that the firm may otherwise prefer to keep private. (LO 2.c)

Module Quiz 2.2

1. **B** *Operational risk* could cover activities pertaining to Jasmine Cellars's input products (i.e., cork) and products exported to foreign countries (i.e., bottles of wine). In addition, there would be *pricing risk* for both the inputs and outputs. For example, the cost of the cork may have a significant impact on Cellars's ability to conduct business in a competitive manner. Also consider that Cellars has sales to customers in foreign countries (with payment in the foreign currency) where there is the risk of the devaluation of the foreign currency in the future. *Financial position risk* refers to the balance sheet of a firm. Neither the purchases nor the sales impact Cellars's balance sheet. (LO 2.d)
2. **A** A futures contract does not provide customization. The firm wants to reduce basis risk and provide for a complex and dynamic cash flow pattern. (LO 2.e)

The following is a review of the Foundations of Risk Management principles designed to address the learning objectives set forth by GARP®. Cross-reference to GARP FRM Part I Foundations of Risk Management, Chapter 3.

Reading 3

THE GOVERNANCE OF RISK MANAGEMENT

Study Session 1

EXAM FOCUS

This topic focuses on corporate governance, which is how companies operate, and includes the roles of shareholders, senior managers, and the board of directors. For the exam, pay attention to the best practices in corporate governance and risk management, as well as the interdependence of functional units within a firm's risk management ecosystem. In addition, understand the purpose and function of the main board committees, such as risk management, compensation, and audit.

MODULE 3.1: CORPORATE GOVERNANCE AND RISK MANAGEMENT

In a very broad sense, **corporate governance** is the series of processes established to operate a business. It involves shareholders, senior management, and ultimately, the board of directors. This discipline has evolved from a vague principle to a series of well-defined best practices in the wake of several high-profile corporate governance failures [e.g., Enron (2001), WorldCom (2002), Global Crossing (2002), and Parmalat SpA (2003)]. As is often the case, U.S. federal legislation (regulation) develops as a result of a systemic failure. The **Sarbanes-Oxley Act (SOX)** of 2002 was once such effort. It imposes strict financial reporting and auditing parameters on public companies.

PROFESSOR'S NOTE

European regulators decided not to enact a SOX-like rule in their jurisdiction. Instead, they chose voluntary reform using a "comply-or-explain" model where businesses could elect to not comply with recommended best practices as long as they explained their reasoning.

On July 30, 2003, SOX went into full effect in the United States. This regulation had several important practical implications:

- Chief financial officers (CFOs) and chief executive officers (CEOs) must personally verify and certify the accuracy of financial filings with the Securities and Exchange Commission (SEC).
- CFOs and CEOs must attest that all disclosures provide an accurate picture of the firm.

- Certain internal controls (e.g., board of director and audit committee composition) are required, and any deficiencies (including uncovered fraudulent activity) must be promptly and accurately disclosed to investors and regulators.
- The firm's reporting procedures and internal controls must be audited annually.
- Audit committee member names must be publicly disclosed, and they must
  – be able to understand accounting principles,
  – be able to comprehend financial statements, and
  – have audit experience.

Regulation and Governance After the Global Financial Crisis

LO 3.a: Explain changes in regulations and corporate risk governance that occurred as a result of the 2007-2009 financial crisis.

The financial crisis of 2007–2009 has been linked to several risk management failures. The heart of the crisis revolved around there being too many securitized mortgage products (i.e., mortgage-backed securities) that were linked to subprime (i.e., high-risk and low-borrower quality) loans. When the subprime loan default rates rose, the associated mortgage-backed securities caused massive losses throughout the financial system. Some firms were taken to the edge of bankruptcy while others (e.g., Lehman Brothers) were forced to stop operations.

Through the financial crisis, it became apparent that many different financial institutions and ratings agencies did not have adequate risk appraisal and control systems. These failures flowed from declines in underwriting standards, a general breakdown in oversight (i.e., management being more concerned with short-term profits than long-term ethical decision-making), and overuse of complicated structured products. The recently enacted SOX was not sufficient to prevent the next crisis, which began in the United States but spilled over into a global crisis from which it took years to recover.

The following is a list of some of the key lessons learned from risk management failures during the financial crisis, with respect to the banking industry:

- *Stakeholder priority*. Some firms have a diverse set of stakeholders, such as depositors (banking sector), borrowers (banking sector), regulators, employees, bondholders, and shareholders. At times, this widely diverse group has competing needs, which makes risk management challenging.
- *Board composition*. The financial crisis did not provide clear guidance on the traditional advice for board composition to be independent, engaged in the process of supervision, and a collection of professionals who hold a level of industry expertise. In particular, the banking sector showed no difference in outcome, whether board directors were internal or external stakeholders. This reality confounds traditional logic and was probably the result of external forces that could not be mitigated by independence.
- *Board risk oversight*. One very clear lesson from the crisis is that board members need to be very proactive in the risk management process. Education for board members is necessary to ensure recognition of the importance of this role and the link between the board and the risk management infrastructure.

- *Risk appetite*. The board needs to clearly articulate and communicate the firm's risk appetite to stakeholders. This risk budget should be translated into an enterprise-level risk limit system.
- *Compensation*. The board should exercise control over management compensation regimes to not incentivize undesired risk-taking behavior. Compensation structures that use deferred bonus payments and clawback provisions should be considered.

In the wake of a series of banking-oriented crisis, global banking regulators pooled their intellectual resources to form the Basel Committee on Banking Supervision (BCBS). This organization is comprised of banking regulators (many of them central banks) from 27 global jurisdictions. They devised a series of standards, which follow. These standards are not legally binding, although they do present sound risk management best practices for firms willing to apply the guidance.

- *Basel I.* The Basel Accord of 1988 (Basel I) created a uniform approach for banking capital adequacy standards. Basel I flowed out of the preceding Latin American debt crisis. This accord focused on managing credit risk by recommending minimum capital of 8% of a bank's risk-weighted assets.
- *Basel II*. The Basel II framework replaced Basel I in 2006. This regime included both trading and lending activities in capital adequacy standards. Basel II also imposed disclosure suggestions and standards for bank supervision by regulators.
- *Basel III*. In a direct response to the financial crisis of 2007–2009, Basel III was born. This system factors both company-specific (idiosyncratic) risk and market-level (systematic) risk.

The current regime (Basel III) limits **Tier 1 capital** (a core measure of a bank's strength) to include common equity and retained earnings. It also imposes a **liquidity coverage ratio**, where banks must hold enough highly liquid assets to fund 30-day's worth of cash needs. A **net stable funding ratio** was also established to encourage banks to have at least one year's worth of stable cash flow to fund required operations. The last step was to add a **macroprudential overlay** to lessen systematic risk and procyclicality. This overlay consists of five elements:

1. A leverage ratio (Tier 1 capital/total consolidated assets) cap of 3%.
2. A countercyclical capital buffer.
3. All global systemically important banks have minimum total loss-absorbing capital standards.
4. Because of concerns about systemically important markets and infrastructures, Basel III is encouraging as many trades as possible to be centrally cleared. This step is to minimize counterparty risk.
5. Risk modeling and stress testing are being modified to better capture tail risk.

In 2015, the BCBS issued revised guidelines for banking sector risk management. They are summarized as follows:

1. *Responsibility of the board of directors*. The board has the ultimate responsibility to oversee senior management's implementation of the firm's risk appetite, strategic objectives, and governance framework.

2. *Board composition*. All board members should be qualified for their supervisory responsibility. They must have topical knowledge as well as the skillset necessary to execute their duties.
3. *Policies of the board*. The board should establish policies for its own operation that reinforce their objectives.
4. *Senior management*. The firm's senior management should conduct the day-to-day business operations in accordance with the strategy approved by the board.
5. *Governance for a conglomerate*. A conglomerate is a business that is a compilation of several other businesses. This is often structured with a parent firm and several child firms which conduct daily operations in different functions. The board of the parent firm needs to have ultimate oversight over the operations of all members of the conglomerate.
6. *Risk management function*. There should always be an independent risk management function that reports to the board under the daily supervision of a chief risk officer (CRO).
7. *Risk identification, monitoring, and control*. The board has the ultimate responsibility to oversee risk mapping (identification). Once risks are identified, the board needs to direct the process of determining if a risk should be retained, avoided, mitigated, or transferred. Incumbent in this process is the responsibility to monitor dynamic risks on an ongoing basis.
8. *Risk communication*. A robust risk management system requires effective communication about the firm's risk appetite and risk management process to all levels of the firm.
9. *Compliance*. The board is ultimately responsible for overseeing compliance risk management.
10. *Internal audit*. Periodic audits should be conducted to inform the board of the firm's progress on their risk management process.
11. *Compensation*. The board should organize and supervise the firm's compensation structure such that management is held financially accountable for risk decision-making.
12. *Disclosure*. The firm's risk management process should be adequately disclosed to stakeholders.

In 2016, Basel III was expanded to include the **Fundamental Review of the Trading Book (FRTB)**. This framework is intended to broaden the inclusion of market risk exposures. The focus for FRTB is on risk introduced through a bank's trading desk in derivatives, futures (including currency and index exposures), and other complex financial assets.

While the financial crisis of 2007–2009 prompted Basel III, it also resulted the **Dodd-Frank Act**. A little background information is helpful to properly understand Dodd-Frank. Previous to 1999, banks operated under the Glass-Steagall Act, which prohibited commercial banks from operating investment banking divisions in the same firm. The core idea was to protect depositors from trading volatility. The Graham-Leach-Bliley Act (introduced in 1999) removed this barrier and permitted bank holding companies to reform as financial services holding companies (FSHCs). These FSHCs could combine commercial (depository) banking

under the same corporate umbrella as investment banking, insurance, and broker-dealer services. The result of overwriting Glass-Steagall was that Bear Sterns and Merrill Lynch were in such distress that they needed to be merged into larger (more stable) financial institutions and Lehman Brothers went bankrupt. After the financial crisis, the Dodd-Frank Act was enacted (in July 2010) to address several issues related to financial consumer protection and market stability. A list of seven key elements of Dodd-Frank follows:

1. *Strengthen the Fed*. The Federal Reserve Bank (i.e., the Fed) was given oversight over all systemically important financial institutions (SIFIs) with assets greater than $50 billion.
2. *Ending too big to fail*. This legislation ended the *too big to fail* theory and created an orderly liquidation authority to deal with failure of a large financial institution.
3. *Resolution plan*. All SIFIs are required to submit a *living will* to the Fed. This document should outline governance resolution planning in the event of corporate distress.
4. *Derivatives markets.* Dodd-Frank attempted to create more transparency in derivatives markets by reducing counterparty risk. Note that this concern was clearly echoed in Basel III as well.
5. *The Volker Rule.* This infamous rule would re-impose some of Glass-Steagall by prohibiting banks from engaging in proprietary trading (trading with the bank's money).
6. *Consumer protection.* Dodd-Frank created the Consumer Financial Protection Bureau to regulate consumer-facing financial products.
7. *Stress testing.* Robust and dynamic stress testing must include a top-down approach that incorporates macroeconomic shocks and their impact on several types of risk (e.g., credit risk, liquidity risk, market risk, and operational risk). This stress testing must be incorporated in a bank's liquidity planning process, and the outcome will be evaluated at the bank level and at the economy level by the Fed. There is one stress test performed by the Fed for banks with assets above $10 billion (i.e., the Dodd-Frank Act Stress Test) and another test for banks with assets exceeding $50 billion (i.e., the Comprehensive Capital Analysis and Review).

PROFESSOR'S NOTE

Europe has also begun considering its own Dodd-Frank replica, which they call the Supervisory Review and Evaluation Process. This rule requires stress testing and a forward-looking basis for risk planning purposes.

Governance of Risk Management Best Practices

LO 3.b: Describe best practices for the governance of a firm's risk management processes.

Corporate Governance

The board of directors should be comprised of a majority of independent members to maintain a sufficient level of objectivity with regard to making decisions and approving management's decisions. All members should possess a basic knowledge of the firm's

business and industry, even if they are outside of the industry. Additionally, those who lack knowledge should be provided some supplemental training before joining the board.

Recently, the standard view that the board is responsible for serving the best interests of shareholders has evolved into a concern for all stakeholders of the firm. This can present a challenge because stakeholder interests are not always homogenous. For example, debtholders are most concerned with downside risk. They want their payments to be secure. However, stockholders would prefer reasonable risk-taking behavior in the pursuit of superior returns. Adding in the concerns of regulators, employees, and society further complicates the matrix of stakeholder interests.

Conflicts of interest is a major focal point for the board. This is traditionally thought of as **agency risk**, which is risk associated with owners and operators of a business being different groups of people. This is an ever-present concern for the board. One vantage point for agency risk considers management incentives to take short-term risks and ignore potential long-term impact. For example, many stock-based compensation schemes provide managers option grants if they reach short-term targets without consideration for the long-term influence of business decision-making. The board should be aware of any agency risks whereby management may have the incentive to take on greater risks to maximize personal remuneration (e.g., based on short-term increases in stock price) that are not consistent with the objectives of the stakeholders in terms of long-term risk levels. As a starting point, the compensation committee within the board should design management compensation plans so they are congruent with corporate goals in addition to minimizing or reducing agency risk. Adding long-term goals and a **clawback provision** (where managers repay bonuses if certain actions occur) are some ideas to help in this area.

Conventional wisdom suggests that the board should remain independent from management. This insight translates into practice when the roles of the CEO and the chairperson of the board are two different (and independent) people. The board should also consider the introduction of a CRO who helps the board understand the firm's risk mapping and risk management process.

Consider an example using MF Global, which illustrates the importance for board independence and the role of a CRO. In 2010, Jon Corzine held the dual roles of CEO and chairman of the board of MF Global. Corzine ignored the warnings of his CRO and placed substantial proprietary trades in European debt instruments. The Greek government was in the middle of a debt crisis, which spilled over into many other European sovereign issues. The result was catastrophic losses of approximately $1.6 billion for MF Global that ultimately resulted in their bankruptcy. There was no counterbalance to the CEO's decision-making because the CEO was also the chairman of the board. These roles should be separate and independent for stakeholder protection.

Risk Management

Each successive macro-level crisis or corporate failure reinforces the need for the board of directors to play a central role in a firm's risk management process. This need requires the board to understand the firm's known risks, their potential impact, and to articulate an enterprise-level risk appetite. It is also the board's responsibility to ensure that the firm's risk appetite is adequately and clearly communicated to stakeholders.

The board of directors should encourage the firm to strive for economic performance, not accounting performance. This can be accomplished by ensuring that business decision-making is consistent with both authorized risk limits and strategic business goals. The board and a sound risk management mindset should influence strategic planning as well. In addition, the board should be prepared to pose probing and relevant questions to management and other staff in the context of professional skepticism. Corroborating information from a variety of sources and staff should increase the reliability and validity of the answers obtained.

From a practical perspective, the board should take the following steps in executing their risk management duties:

1. Clearly articulate an enterprise-level risk appetite.
2. Determine whether known risks should be retained, avoided, mitigated, or transferred.
3. Establish and maintain a CRO role that reports directly to the CEO with ongoing access to the full board as needed.
4. Establish a risk committee that is comprised of individuals who are knowledgeable in the risks faced by the firm.
5. Connect the work of the compensation committee with the firm's risk appetite and the work of the risk committee.
6. Maintain an independent audit committee that can monitor relevant actions.

MODULE QUIZ 3.1

1. Which of the following statements was a lesson learned in the aftermath of the financial crisis of 2007–2009?
   A. Firms need to prioritize stakeholder interests when diverse/competing stakeholder goals are present.
   B. There should be independence on the board of directors, and the role of chief executive officer (CEO) and chairperson should be combined when possible.
   C. It is the firm stakeholders who bear the responsibility to clearly articulate an enterprise-level risk appetite.
   D. The chief risk officer should exercise control over management compensation regimes to not incentivize undesired risk-taking behavior.
2. Which of the following statements is not a key responsibility of the board of directors relative to risk management?
   A. Establish an enterprise-level risk appetite.
   B. Establish an audit committee, which is chaired by the firm's chief financial officer (CFO).
   C. Establish a risk committee to inform the risk management process for the full board.
   D. Establish and maintain a chief risk officer (CRO) role that reports to the chief executive officer (CEO) but retains full access to the board.

MODULE 3.2: RISK GOVERNANCE IMPLEMENTATION

LO 3.c: Explain the risk management roles and responsibilities of a firm's board of directors.

In terms of risk governance, the board has some important responsibilities that could be facilitated with the involvement of a risk advisory director. Given the specialized role of the risk management and compensation committees, the specific duties of the risk advisory director are highlighted here.

Risk Advisory Director

Sometimes, a firm's board can include many individuals with experience from outside the firm's industry. When this happens, it is recommended to have an independent **risk advisory director** — a board member who intimately understands the risk factors of a given industry and can advise the board on specialized risk exposures. This individual should attend risk committee and audit committee meetings to provide industry-specific guidance. The risk advisory director also meets with senior management on a regular basis and could be viewed as a liaison between the board and management. Overall, the role involves educating members on best practices in both corporate governance and risk management.

With or without the assistance of a risk advisory director, the board's duties include the review and analysis of the following:

- The firm's risk management policies
- The firm's periodic risk management reports
- The firm's risk appetite and its impact on business strategy
- The firm's internal controls
- The firm's financial statements and disclosures
- The firm's related parties and related party transactions
- Any audit reports from internal or external audits
- Corporate governance best practices for the industry
- Risk management practices of competitors and the industry

Risk Management Committee

The risk management committee (a subset of the full board of directors) is responsible for setting the firm's risk appetite and independently monitoring ongoing risk management. Members will maintain contact with both internal and external auditors to ensure compliance with all relevant policies (e.g., regulations and internal risk limits). This committee is also charged with supervision of all known risks of the firm and approving high-level risk decisions. In a banking context, they would be involved with approving credit facilities that are above certain limits or within limits but above a specific threshold.

Compensation Committee

As discussed previously, the existence of agency risk necessitates the board to implement a compensation committee to ensure appropriate risk taking in relation to the long-term risks assumed. The compensation committee is independent of management. Its role is to discuss and approve the remuneration of key management personnel.

Management compensation above base salary should be congruent with the goals of the other stakeholders. In that regard, the committee should avoid designing compensation plans (e.g., stock-based compensation) with bonuses based on short-term profits or revenues, given the relative ease in which management may manipulate those amounts. Furthermore, the committee may consider introducing elements of downside risk with management compensation. For example, compensation may be deferred until long-term results are known, or there could be clawbacks of previous bonuses paid if long-term results are inconsistent with short-term results. Another idea is to provide *bonus bonds* as compensation that would be taken away should a specific regulatory ratio requirement be breached.

Risk Appetite vs. Business Strategy

LO 3.d: Evaluate the relationship between a firm's risk appetite and its business strategy, including the role of incentives.

There must be consistency between the firm's risk appetite and its business strategy. If the firm's strategic goal is to make profitable loans, then risk limits will impose credit risk parameters. If the goal is smooth operations, then futures may be needed to address operational risks or foreign currency risks. In all circumstances, a firm's risk appetite should reflect its tolerance to accept risk.

Understanding the risk supervision hierarchy is important in pursuit of linking risk tolerance to business strategy. The board sets the enterprise-level risk appetite through the risk committee, which is a subset of the full board. The CRO is responsible for day-to-day risk supervision and is able to approve temporary breaches of communicated risk limits as long as the enterprise-level risk limits are still within board-established tolerance bands. The CRO should report to the CEO; however, the CRO functionally operates as a liaison between the board and senior management. The CRO will also sit on the firm's senior risk management team (along with the CEO, the CFO, the treasurer, the chief compliance officer, and executives in charge of each function business unit).

It can sometimes be a challenge to strike a balance between business objectives/opportunities and risk limits. There exists a natural tension where an activity fits the business objectives but not the risk goals. For example, a bank might be considering a potentially profitable new loan that would extend beyond approved credit risk limits. The CRO (and ultimately the risk committee) can approve an extension or decline the loan.

The risk appetite is operationalized through risk limits, which can be monitored through stress testing and value at risk (VaR) analysis at both the asset-class-level and at the business unit level. Functionally, the limits should be designed such that normal business activity will not trigger a limit breach and there should be a margin for error built into the process. As risks are monitored (on an intraday basis) by frontline employees, exceptions (risk limit breach requests) will exist. The CRO should have an active plan to identify these requests in writing, and consider approval of temporary limit extensions to minimize opportunity costs. It is very important that any risk limit exceptions be documented in writing (in the daily risk limit exception report) and presented to the risk committee for its awareness and review.

Relatedly, the compensation committee needs to ensure that managerial remuneration reinforces the firm's risk appetite. In many cases, bonus structures incentivize short-term profits and ignore long-term risk exposures. In this manner, bonus structures often have an asymmetric, call option-like payoff profile in which managers enjoy the gain of profits but avoid the pain of losses. Compensation regimes need to be reimagined as a part of the firm's risk culture. In the wake of the financial crisis of 2007–2009, the G20 countries recommended a specific series of managerial compensation reforms, which are enumerated as follows:

1. Eliminate multi-year bonus guarantees.
2. Make supplementary compensation symmetrical by using deferred payment features and clawback provisions to encourage long-term thinking.
3. Limit the amount of incentive-based compensation (often set at 100% of salary or 200% with shareholder approval).
4. Establish disclosure requirements to make compensation packages more transparent for stakeholders.
5. Affirm the independence of the compensation subcommittee of the full board.

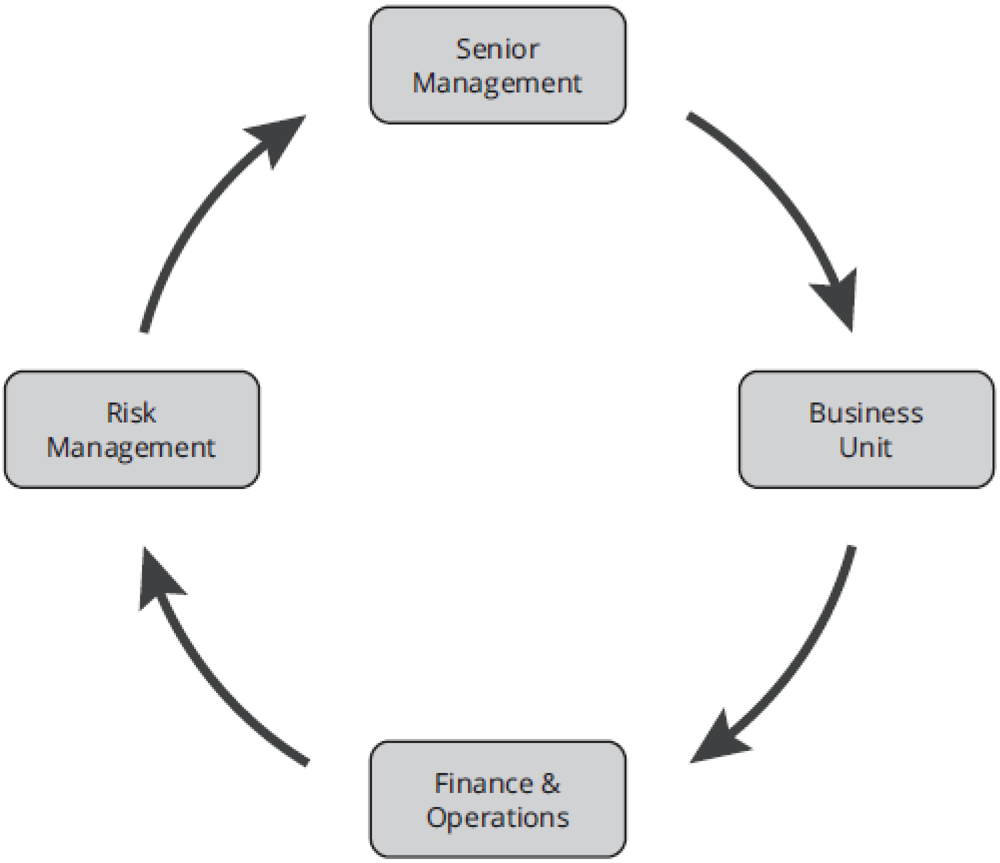
Recently, compensation committees have devised a new structure known as a **bonus bond**, which is a bond that only pays a benefit if certain thresholds are met. The Swiss bank, UBS, uses this system, and their executives will lose the bonus bond if regulatory capital ratios fall below 7.5%.

Interdependence of Functional Units

LO 3.e: Illustrate the interdependence of functional units within a firm as it relates to risk management.

The various functional units within a firm are dependent on each other when it comes to risk management and reporting. While the risk committee oversees the firm's risk management process and the CRO monitors day-to-day risk limits, it is the frontline managers and employees who implement the firm's risk policy. The interdependence of managing risk among these functional units is illustrated in Figure 3.1.

Figure 3.1: Interdependence



There are many examples of interdependence among the functional units. Senior management (with supervision and assistance from the risk committee) sets the firm's risk appetite, designs and oversees risk policy, and evaluates performance relative to risk limits. At the business unit level, the firm's approved risk policy is implemented, and any exceptions are promptly identified. The finance and operation functions physically execute risk mitigation and transfer transactions. They also analyze current risk management tools to ensure that risk limits are maintained, and these departments help in the risk and business planning processes. The risk management function (led by the CRO) monitors risk limits and controls, manages the risk management process, and regularly communicates with senior management and the risk committee.

Audit Committee

LO 3.f: Assess the role and responsibilities of a firm's audit committee.

The audit committee (a subcommittee of the full board) has traditionally been responsible for the reasonable accuracy of the firm's financial statements and its regulatory reporting requirements. They also have responsibilities related to the firm's risk management process. They need to ensure that board-established policies are being followed and that those policies are sufficient to adequately monitor and control risk exposures.

The firm's internal auditors report to the audit committee and they are responsible for monitoring risk management procedures, tracking the progress of existing systems, and affirming the efficacy of the existing policies/systems. In addition, the internal auditors should also verify adherence to compliance standards and offer an opinion on the validity of

calculated risk metrics like VaR. When market risk is involved, the audit function should validate any pricing models (e.g., derivatives valuation) used for risk monitoring. Another key role is to offer an opinion on the assumptions (i.e., volatility, correlations, etc.) used in internal risk estimation. In January 2017, the Institute of Internal Auditors issued a revised set of standards, which are country-specific, to help direct audit standards to a minimum level of robustness.

A central requirement for a viable audit committee is independence from the underlying business activity. The audit function needs to remain independent from the day-to-day implementation of risk management policies. Additionally, all members of the audit committee must possess sufficient financial knowledge to perform in their role. This requires an understanding of the relevant accounting rules (e.g., U.S. GAAP, IFRS), financial statements, and internal controls. As a collective, there should be a proper balance of independence, knowledge of the business, and ability to ask probing and relevant questions. The audit committee is largely meant to be independent of management, but it should work with management and communicate frequently to ensure that any issues arising are addressed and resolved.

MODULE QUIZ 3.2

1. The role of a risk advisory director is to:
   A. lead the compensation committee.
   B. assume responsibility for setting the enterprise-level risk appetite.
   C. provide advice to the executive team of the company.
   D. provide risk-oriented expertise to the board when it is primarily comprised of people from industries unrelated to the subject firm.
2. Which of the following statements regarding the firm's risk appetite and/or its business strategy is most accurate?
   A. The firm's risk appetite does not consider its willingness to accept risk.
   B. The board needs to work with management to develop the firm's overall strategic plan.
   C. Management will set the firm's risk appetite and the board will provide its approval of the strategic plan.
   D. Management should obtain the risk management team's approval once the business planning process is finalized.
3. The various functional units of a firm are highly interconnected. Which unit is responsible for executing risk mitigation and transfer?
   A. Senior management.
   B. Individual business units.
   C. Finance and operations.
   D. Risk management office.
4. Which of the following statements regarding the role of the firm's audit committee is most accurate?
   A. At least one member of the audit committee must possess sufficient financial knowledge.
   B. The audit committee has responsibilities related to the firm's risk management process.
   C. The audit committee is only responsible for the accuracy of the financial statements.
   D. The audit committee is meant to work dependently with management.

KEY CONCEPTS

LO 3.a

The risk management failures during the financial crisis of 2007–2009 taught several key lessons:

- The needs of all of the firms' stakeholders must be considered.
- The board needs to have competent and independent directors.
- The board needs to take a highly proactive role in the firm's risk management process.
- The firm's risk appetite needs to be clearly articulated by the board.
- Compensation should be structured to better align management behavior with long-term stakeholder priorities as determined by the board.

Basel III and the Dodd-Frank Act were also issued in response to the financial crisis of 2007–2009. Their goals are to focus banks on capital adequacy measures and to prevent commercial banks from engaging in proprietary trading (among other things).

LO 3.b

Best practices in corporate governance include factors like board member independence, competency standards for board members, consideration of all stakeholders, and structuring managerial compensation packages to flow out of risk management goals. There should also be separation between the CEO and the chairperson of the board so that there is true accountability (i.e., there needs to be two different individuals, not one). One of the duties of the board is to supervise the risk management process. Best practices for risk management include adequately mapping risks and specifying an enterprise-level risk appetite, which needs to be communicated throughout the organization.

LO 3.c

The board of directors has ultimate responsibility for enterprise-level risk management. If the board does not have sufficient expertise to adequately understand, map, and manage the firm's risk exposures, then they need to recruit a risk advisory director (an independent expert in industry-specific risk factors) to the board and to the risk management committee. The risk management committee will make all risk appetite decisions and then bring these discussions back to the full board for their awareness. The compensation committee is charged with aligning managerial compensation with long-term stakeholder needs.

LO 3.d

A firm's risk appetite must fit with its business strategy. This process involves an in-depth understanding of the firm's objectives. Sometimes the risk appetite will limit available opportunities. For example, a bank may need to decline a loan if it would push the bank over its risk limits. Compensation should also be aligned to encourage long-term risk awareness and not reward only short-term profit-seeking behaviors.

LO 3.e

The various functional units of a firm are interconnected. Senior management, business units, finance and operation functions, and risk management all work together to conduct the firm's risk management process. Frontline managers are vital in this process and the

CRO communicates progress to senior management and the risk committee on a very regular basis.

LO 3.f

The audit committee is a subcommittee of the full board. Members traditionally monitor compliance with accounting standards, but they also have a role to play in supervision of risk management policies. They need to verify that policies are being followed and offer opinions on the variables used in testing exposures, as well as the functional value of the current risk management systems. These opinions are informed by internal auditors and are collected and transferred to the full board for further consideration.

ANSWER KEY FOR MODULE QUIZZES

Module Quiz 3.1

1. **A** When a firm has a diverse group of stakeholders with potentially competing interests, the board needs to prioritize which stakeholder goals will have the highest priority. The board should include independent members, but the role of CEO and chairperson should be separated if possible. When they are combined, there is a potential governance issues because the chairperson cannot effectively supervise the CEO if they are the same person. The board of directors is responsible for articulating enterprise-level risk appetite. Their decision is usually informed by the work of risk committee. The board should exercise control over management compensation regimes to not incentivize undesired risk-taking behavior. (LO 3.a)

2. **B** The board of directors does establish an enterprise-level risk appetite. They should establish an audit committee, but it must be independent from management. It would be a conflict of interest to have the CFO on the committee, much less acting as the committee chair. The risk committee is a subset of the full board, and they inform the risk management process for the full board. Another responsibility is to create a CRO role who will report to the CEO but retains access to the full board if any issues arise. (LO 3.b)

Module Quiz 3.2

1. **D** A risk advisory director is a board member who is brought in specifically to provide industry-specific risk expertise to board members who are from other industries. This individual is a member of the full board and may be placed on other committees such as the compensation committee, the risk committee, or the audit committee without a mandatory mandate for leadership. This person’s role is to advise the board and not just the executive team. (LO 3.c)

2. **B** The board needs to develop/approve the firm’s risk appetite as well as assist management in developing the firm’s overall strategic plan. The firm’s risk appetite considers its willingness to accept risk. Both management and the board will set the firm’s risk appetite. Management should involve the risk management team in the business planning process right from the outset to ensure the consistency between risk appetite and business strategy. (LO 3.d)

3. **C** Each functional unit has a role to play. Senior management sets risk policy. Business units implement risk policy. The finance and operations unit executes risk mitigation and transfer strategies, while the risk management office supervises and manages the overall risk management process. (LO 3.e)

4. **B** The audit committee has responsibilities related to the firm's risk management process. All members of the audit committee have responsibilities related to the firm's risk management process. The audit committee is responsible for the accuracy of the financial statements but that alone does not comprise its main responsibility. Additionally, the audit committee monitors the underlying systems in place regarding financial reporting, regulatory compliance, internal controls, and risk management. The audit committee is largely meant to be independent of management, but it should work with management and communicate frequently to ensure that any issues arising are addressed and resolved. (LO 3.f)

The following is a review of the Foundations of Risk Management principles designed to address the learning objectives set forth by GARP®. Cross-reference to GARP FRM Part I Foundations of Risk Management, Chapter 4.

Reading 4

CREDIT RISK TRANSFER MECHANISMS

Study Session 1

EXAM FOCUS

This reading focuses on ways credit risk can be mitigated and transferred by a bank. For the exam, understand how credit default swaps (CDSs) and collateralized debt obligations (CDOs) enable risk transfer, and the role that credit derivatives played in the financial crisis of 2007–2009. Also, understand the various mechanisms for risk transfer, including marking-to-market, exposure netting, and the collateral process. Finally, be familiar with the securitization process and the originate-to-distribute model.

MODULE 4.1: CREDIT RISK TRANSFER

Types of Credit Derivatives

LO 4.a: Compare different types of credit derivatives, explain their applications, and describe their advantages.

Credit risk, the risk of a borrower defaulting, is the core risk exposure held by a bank. Alan Greenspan, the chairman of the Federal Reserve Bank in 2002, argued that the U.S. banking system weathered the 2001–2002 economic slowdown by using novel credit risk transfer tools, including CDSs, CDOs, and collateralized loans obligations. These credit derivatives are essentially off-balance sheet instruments that enable institutions to isolate and transfer very specific risk exposures.

PROFESSOR'S NOTE

There are a few challenges that each counterparty to a credit derivative needs to consider. They should understand the credit risk exposure being retained, what could trigger a loss, and all obligations associated with their directional bet (i.e., buying or selling the credit derivative).

Credit Default Swaps

Credit default swaps (CDSs) are financial derivatives that pay off when the issuer of a reference instrument (e.g., a corporate bond or a securitized fixed income instrument) defaults. This is a very direct way to measure and transfer credit risk. These derivatives function like an insurance contract in which a buyer makes regular (quarterly) premium payments, and in return, they receive a payment in the event of a default.

Advantages of CDSs include:

- *Spur innovation*. Conceptually, CDS buyers are protected from credit risk. This enables them to fund riskier opportunities than they otherwise might comfortably support. This access to capital could spur innovation and boost economic growth.
- *Cash-flow potential*. CDS sellers create a stream of payments that could be a significant source of cash flow. Theoretically, they can diversify the CDS contracts across industries and geographies such that defaults in one area should be offset by fees from CDSs that have not been triggered through default.
- *Risk price discovery*. The use of a CDS enables price discovery of a specific credit risk. Bonds also provide credit risk price discovery, but this service is blurred because their prices also include other risks, such as interest rate risk. A CDS is a pure play on pricing a given borrower's credit risk.

Disadvantages of CDSs include:

- *Historically weak regulation*. CDS contracts were unregulated until after the financial crisis of 2007–2009. Lack of regulation meant that counterparty risk existed because CDS buyers were not guaranteed that the CDS seller could make good on the promise of credit risk mitigation.
- *False sense of security*. The presence of a CDS contract creates a false sense of security for fixed income buyers, who could support an issuer that is far riskier than they would support without the presence of credit risk transfer. This can be both an advantage (access to capital) and a disadvantage (excessive risk-taking behavior), depending upon one's vantage point.

Collateralized Debt Obligations

A **collateralized debt obligation (CDO)** is a structured product that banks can use to unburden themselves of credit risk. These financial assets are repacked loans which are then sold to investors on the secondary markets. A CDO could include some combination of **asset-backed securities (ABSs)** which could include mortgages (commercial or residential), auto loans, credit card debt, or some other loan product. Typically, the loans included in a CDO are heavily biased toward mortgage debt through a securitized basket of mortgages called a **mortgage-backed security (MBS)**. When a CDO consists only of mortgage loans, it is technically known as a **collateralized mortgage obligation (CMO)**.

A CDO may also contain securitized short-term corporate borrowings through a product called **asset-backed commercial paper**. Sometimes, a CDO will contain repackaged portions of another collateralized debt obligation that could not be sold directly to investors. This product is then called a **CDO-squared**, and it enables riskier portions of loans to be bundled with lower-risk loans to attract investor interest. The added complexity of a CDO-squared is primarily intended to make the product easier to market to potential investors and not to enhance risk mitigation potential.

Financial engineers determine how to organize a CDO's constituent loans into investable **tranches** (a French word meaning *slices*). These tranches are structured to distribute credit risk and to meet rating agency requirements. The most junior tranche offers a high interest rate but receives cash flows only after all other tranches have been paid. For this reason, this

most junior tranche is sometimes referred to as the *equity* tranche or even *toxic waste*. Above the equity tranche are the *mezzanine* tranches, which receive payment before the junior tranches. The highest-rated tranche, called the *super senior* tranche (often rated AAA), is the safest tranche and the first tranche to be paid out; however, it pays investors a relatively low interest rate.

Advantages of CDOs include:

- *Increased profit potential*. Banks have the ability to source loans, repackage them into a structured product, and then use the proceeds from selling the repackaged loans to source new loans. This cycle enables banks to increase loan turnover and therefore increase profit potential.
- *Direct risk transfer*. Through the securitization process, banks will effectively transfer credit risk to investors.
- *Loan access*. Since the bank is repackaging and selling the loans, individuals who otherwise might not be able to access a loan may now have access.

Disadvantages of CDOs include:

- *Encourages increased risk taking*. Since banks have the ability to transfer credit risk, they may source loans that are riskier than they otherwise would accept. This behavior could result in unexpected risk for investors.
- *Risk concentration potential*. These structured products could unknowingly (on the part of investors) concentrate exposure to high-risk borrowers, who may default and cause investors to experience unexpected losses.
- *High complexity*. Structured products are very complex. They may be difficult for an investor, a rating agency, or a regulator to fully understand.

Collateralized Loan Obligations

A **collateralized loan obligation (CLO)** is a structured product that is extremely similar to a CDO. Like a CDO, they are a bundle of repackaged loans that are organized into tranches. However, a CLO's constituent loans are predominantly bank loans, which have typically been exposed to a rigorous underwriting process. CLOs did not experience the same level of defaults that plagued the CDO market (largely due to heavy exposure to mortgages in the CDO space). For this reason, CLOs continued to attract investor interest in the wake of the financial crisis of 2007–2009, while CDOs lost interest quickly.

Reducing Credit Risk Exposure

LO 4.b: Explain different traditional approaches or mechanisms that firms can use to help mitigate credit risk.

Beyond the direct use of credit derivatives, banks have several different traditional approaches that can be used to transfer credit risk. These mechanisms are listed as follows:

- *Purchase third-party insurance*. A bank can directly purchase insurance against the failure of either a single borrower or a group of borrowers. If a single borrower is being insured, then this insurance overlay is technically called a **guarantee**. This is

routinely done when issuing loans to municipalities. The Municipal Bond Insurance Association is one example of a firm that provides third-party insurance specifically to the municipal bond market.

- *Exposure netting*. When a bank has multiple risk product exposures to the same counterparty, it is common to net those exposures in terms of their ultimate financial impact.
- *Marking-to-market*. Counterparties will periodically revalue credit derivatives and immediately transfer any required payments to the winning counterparty. This prevents the risk of one party not having sufficient funds to make a balloon payment at the end of a credit derivative's maturity. Marking-to-market is primarily used with exchange-traded derivatives.
- *Requiring collateral*. Many banks require that borrowers post collateral when creating a new loan. The collateral may offset the lender's credit risk exposure. However, there is the potential for **wrong way risk**, which occurs when the value of the collateral is negatively impacted by the same factors that cause the firm to potentially default on a loan. For example, an energy company might take out a loan to acquire barrels of oil that are needed in their production process. The barrels of oil are the collateral for the loan. If oil prices drop, then the firm may have operational issues that could trigger a default. At the same time, the value of their collateral has also declined.
- *Termination clause*. A bank might include a clause in a credit risk transfer transaction that would cause the position to terminate if a given trigger event occurs. Examples of triggers could be a downgrade or missing financial metrics (e.g., gross profit levels or interest coverage).
- *Reassignment*. A bank could have an agreement to automatically transfer credit risk to a third party in the event of a trigger (e.g., downgrade).

Additionally, banks may decide to disperse credit risk for a given loan across a number of other lenders. This credit risk tool is known as **syndication**. This mechanism is only used for very large loans. Typically, the lead bank in the syndicate will retain approximately 20% of the loan and find a series of other banks that are willing to hold the remaining 80%. The syndicate arrangement could be either a firm commitment or on a best-effort's basis. A **firm commitment** exists when a lead bank guarantees an issuer that it will get the full loan requested. If the lead bank cannot find other banks to share the credit risk, then they will be forced to assume all risk themselves. However, a syndicate agreement on a **best-efforts basis** provides issuers no guarantee that they will be able to borrow all of the desired funds. The lead bank will do its best to secure partner banks, but if it is not successful, then the issuer may receive fewer loan proceeds than desired.

PROFESSOR'S NOTE

One challenge with the syndication approach is that is does not inherently enable targeted risks to be transferred. The bank will retain all risks associated with the portion of the loan that it retains. Its primary alternative is to use credit derivatives in addition to a syndication approach to transfer any undesired risks.

Credit Derivatives in the Global Financial Crisis

LO 4.c: Evaluate the role of credit derivatives in the 2007-2009 financial crisis and explain changes in the credit derivative market that occurred as a result of the crisis.

The financial crisis of 2007–2009 was a real-world test of how credit derivatives transfer risk. This crisis highlighted a systemic concentration risk that occurred when too few liquidity providers were counterparties for all credit derivatives and the size of the exposure was much larger than market participants realized. Consider that the credit default swap market in 2007 ballooned to $45 trillion in notional value. This was a larger dollar amount than U.S. equities, U.S. Treasuries, and outstanding mortgages combined. In part, it grew as large as it did because of investors buying CDSs against assets that they did not own. They were essentially trying to profit from negative market actions.

As was previously discussed, CDSs hold counterparty risk. This reality came into full view when Lehman Brothers filed for bankruptcy in a surprise event. Approximately $400 billion of Lehman's $600 billion in outstanding debt was covered by CDSs. When they collapsed, the CDS sellers (e.g., American International Group [AIG] and the Citadel hedge fund company) also almost collapsed because they had not anticipated all of the CDS contracts coming due at the same time. When the CDS market collapsed, so did investors' appetites for the risky assets that were being demanded because of the ability to transfer credit risk.

CDOs were also actors in the backdrop for the financial crisis. Recall that a core feature of these structured products is to allow multiple loans to be removed from a bank's balance sheet. These repackaged loans are then bundled into a new fixed income derivative asset and are sold to investors. Essentially, loans to high-risk borrowers were initiated so that they could be repackaged and sold. The frequent use of adjustable-rate loans and subprime (a very high-risk borrower) loans eventually caught up with reality. When the adjustable-rate loans began to hit their rate reset dates, borrowers found themselves unable to pay their debts. The resulting elevated default levels completely halted investor interest in CDO products. This occurrence left banks holding onto a large inventory of loans that they could not repackage and sell any longer.

The Federal Reserve's management of the federal funds rate also had an impact on the crisis. They raised this critical market rate from 2004 to 2006. This raising cycle coincided with rate reset dates on adjustable-rate mortgages. At the same time that consumer payments were rising to unaffordable levels, home prices were falling. This meant that mortgage borrowers could no longer afford their payments and they could not sell their homes. The result was widespread defaults that ultimately rippled through MBSs, CDOs, and CDO-squared products. Ultimately, the problem was not the existence of credit risk transfer tools, but rather the misuse (and sometimes abuse) of these tools.

The Dodd-Frank Wall Street Reform Act of 2009 **(Dodd-Frank)** was created to address regulatory shortcomings that helped allow the storm to build leading up to the financial crisis. The embedded Volcker rule prohibited commercial (depository) banks from proprietary trading and from investing in derivatives (i.e., CDSs). It also required the Commodity Futures Trading Commission to regulate all swap contracts, including CDSs.

More recently, the Securities and Exchange Commission (SEC) added a new rule—**Section 15G**—to the Securities and Exchange Act in 2014. This regulation requires that originators of securitized products (e.g., MBSs, CDOs, and CLOs) must retain at least 5% of the credit

risk on their balance sheet. Section 15G was designed to force originators to be more concerned with the products that they repackage for sale to investors. It is important to note that originators are not allowed to transfer or mitigate this 5% exposure. They must retain this credit risk in its raw form.

Securitization and Special Purpose Vehicles

LO 4.d: Explain the process of securitization, describe a special purpose vehicle (SPV), and assess the risk of different business models that banks can use for securitized products.

Securitization is the general process of repackaging loans into a bundled new product that can be sold to investors on the secondary markets. This process involves four key steps:

1. Create a **special purpose vehicle (SPV)**, which is an off-balance sheet legal entity that functions as a semi-hidden subsidiary of the issuing parent company. An SPV will hold financial assets in such a way that is opaque for investors to analyze.
2. The SPV will use borrowed funds to purchase loan assets from one bank or possibly several banks to create structured products (e.g., CMO, CDO, or CLO).
3. The SPV's constituent loans will be arranged by either seniority or credit rating and structured into tranches to form risk layers within the SPV.
4. The various tranches are then sold to investors on the secondary markets.

There are several types of loans that could be brought into an SPV to form a structured loan product. They may include commercial mortgages, residential mortgages, auto loans, credit card loans, student loans, and other loans that were not able to be repacked in another product within an SPV. Below is a brief historical perspective on securitized products, which eventually evolved into the products that helped form the backdrop for the financial crisis of 2007–2009.

- The first mortgage-backed securities were issued in 1970.
- The first structured CMO was issued by Freddie Mac in 1983.
- Chrysler Financial issued the first auto loan-backed ABS in 1985.
- The first CDO and the first credit card-backed ABS were both issued in 1987.
- CLOs were introduced in early 1990s.

When sourcing loans, banks can choose between two high-level business models. The traditional model is referred to as the **buy-and-hold strategy**. In this approach, banks will source a loan and then retain it on their books. They enjoy periodic interest payments to compensate for holding credit risk. The innovation enabled by securitization is the **originate-to-distribute (OTD) model**. The OTD model involves banks sourcing loans with the explicit intention to securitize them and sell the structured products to investors. With this model, banks do not retain credit risk and they are paid a fee for sourcing the loans that feed into the securitized products rather than receiving interest payments, which belong to the investors in the structured products. The incentive in the OTD model is to generate high loan volume, not high-quality loans, which is the incentive in the buy-and-hold model.

PROFESSOR'S NOTE

Enthusiasm for the OTD model was partially driven by the Basel capital adequacy requirements, which were easier to obtain when certain liabilities were held in an off-balance-sheet format.

Advantages of the OTD model include:

- *Bank profitability*. Short-term earnings volatility could be lowered, and capital could be optimized using the OTD model.
- *Risk management*. Credit risk and interest rate risk could be distributed across various market participants.
- *Investor options*. Investors had new access to a wider selection of credit products. These diversifiers were previously not directly available.
- *Loan access*. The OTD model enabled borrowers access to more credit products with lower borrowing costs.

Disadvantages of the OTD model include:

- *Moral hazard*. Since banks were sourcing and selling loans, they did not have an incentive to ensure the highest underwriting standards were maintained.
- *Misaligned incentives*. The OTD model encouraged a focus on short-term profitability instead of long-term stability or sustainability.
- *Opaqueness*. The lack of transparency in the process for investors made it difficult to accurately understand the risks they were assuming.

The securitization process, which was fed by the OTD model, helped to form the backdrop for the financial crisis of 2007–2009. One of the problems was when banks underestimated the inherent credit risk and held loans that were sourced through an OTD model for their own investing purposes. Sometimes banks would retain securitized products in a highly leveraged off-balance sheet asset known as a **structured investment vehicle (SIV)**. The purpose of a SIV was to profit from interest rate spreads, but it backfired on banks when the underlying loan default rate skyrocketed during the crisis.

PROFESSOR'S NOTE

An SIV is a type of SPV that focuses on the difference between short-term and long-term rates.

MODULE QUIZ 4.1

1. From the perspective of a bank, which of the following is not an advantage of using a collateralized debt obligation (CDO) to transfer credit risk?
   A. Bank profitability can be accelerated due to higher loan turnover.
   B. Credit risk is effectively transferred to investors.
   C. There will always be a market for CDO products.
   D. A larger pool of potential borrowers will exist due to less concern for lending (underwriting) standards.
2. Which of the following is not a traditional credit risk transfer approach used by banks?
   A. Marking-to-market.
   B. Call feature.
   C. Exposure netting.
   D. Loan syndication.
3. Which of the following was not a direct cause of the financial crisis of 2007–2009?
   A. The use of credit derivatives.
   B. Weak regulation.

C. Excessive speculation.
D. Adjustable-rate loan rate resets.

4. Which of the following is not a strength of the securitization process?
   A. Enhances credit product access for low-quality borrowers.
   B. Credit risk can be distributed to multiple market participants.
   C. Enables a transparent four-step process.
   D. Enables borrowers to lower their borrowing costs.

KEY CONCEPTS

LO 4.a

Credit risk is the risk of a borrower defaulting. Three derivative products helped to transfer credit risk leading up to financial crisis of 2007–2009. Credit default swaps (CDSs) enable an investor to transfer credit risk on a loan product to an insurance company. They pay a quarterly insurance premium to buy downside protection. Collateralized debt obligations (CDOs) enable loan originators to repackage loan products into large baskets of loans and then resell those bundles of loans to investors on the secondary markets. A CDO is a structured product that is organized in tranches (slices of bundled loans) with differing exposures to default risk. A collateralized loan obligation (CLO) is very similar to a CDO except that it holds primarily underwritten bank loans as opposed to the mortgage bias of CDOs.

LO 4.b

Banks may use various traditional approaches to transfer credit risk exposures. They include purchasing third-party insurance, exposure netting, marking-to-market, requiring collateral, including termination clauses, and possibly loan reassignment. Another option is to syndicate a loan. In this approach, a lead bank will retain some of the loan and find other banks to hold the remainder of the desired loan amount. These approaches may involve credit derivatives as a part of the risk mitigation strategy.

LO 4.c

The existence of credit derivatives did not cause the financial crisis of 2007–2009, but the misuse of these products certainly did. Investors used CDS contracts for speculation rather than risk mitigation. Collateralized debt obligations also held a very complex mixture of mortgages that included both subprime loans and adjustable-rate loans as well.

There was a perfect storm when the Federal Reserve began raising rates, adjustable-rate loans attained their reset date and produced unaffordable payments, and the housing market declined, causing home prices to drop. This confluence of factors led to massive defaults that rippled through the MBS and CDO markets. Banks then became reluctant to lend to each other while some were going bankrupt. As typically happens after a crisis, new regulation was created. Dodd-Frank was formed to better regulate the credit derivatives space and to keep bank trading in check. The SEC also added Section 15G to further protect investors.

LO 4.d

The securitization process involves a bank sourcing loans, transferring them to an off-balance sheet entity known as a special purpose vehicle (SPV), organizing the loans into

tranches, and ultimately selling the structured loan products to investors. This risk transfer mechanism has potential issues for investors when the originate-to-distribute (OTD) model sources loans with low quality in such a way that disguises this fact from investors. When done right, securitization can enhance loan access and help banks to increase profitability while providing investors with diversification opportunities.

ANSWER KEY FOR MODULE QUIZZES

Module Quiz 4.1

1. **C** Collateralized debt obligations transfer credit risk from banks to investors. This process enables banks to accelerate the loan origination cycle and therefore enjoy potentially higher profitability due to sourcing more loans than would otherwise be accessible. The pool of potential borrowers is increased because banks are less concerned with lending standards. However, when investors lose interest in CDO products due to higher-than-expected default rates, the loan originator (the bank) can be stuck with a large amount of credit risk on their balance sheet. (LO 4.a)

2. **B** Marking-to-market, exposure netting, and loan syndication are all mechanisms that banks use to transfer credit risk. They also might use a termination clause. A call feature could be used to protect an issuer from interest rate risk, but not credit risk. (LO 4.b)

3. **A** The financial crisis of 2007–2009 was made possible by weak regulation and government encouragement of loan to subprime borrowers. Banks responded by sourcing a high number of high-risk loans that ultimately fell apart when adjustable-rate loans reached their reset dates. Investors also speculated very heavily in the CDS and CDO markets. It was the *misuse* of credit derivatives, not merely their use, that led to the crisis. (LO 4.c)

4. **C** The securitization process enhances loan access for low-quality borrowers. It also gives borrowers access to additional credit products at lower borrowing costs. Banks using an OTD model get higher fees for sourcing loans with higher interest rates. Investors get access to higher-yielding loan products as long as default rates are not an issue. The core of this process is to distribute credit risk to multiple market participants. The securitization process is not transparent. (LO 4.d)

The following is a review of the Foundations of Risk Management principles designed to address the learning objectives set forth by GARP®. Cross-reference to GARP FRM Part I Foundations of Risk Management, Chapter 5.

Reading 5

MODERN PORTFOLIO THEORY (MPT) AND THE CAPITAL ASSET PRICING MODEL (CAPM)

Study Session 2

EXAM FOCUS

This reading introduces modern portfolio theory, the efficient frontier, and the capital market line. It then continues to discuss the security market line (SML), the calculation of beta, and the capital asset pricing model (CAPM). For the exam, it is important to have a firm grasp of the CAPM calculation. The reading concludes by reviewing some popular risk-adjusted measures of return, such as the Sharpe measure, the Treynor measure, Jensen's alpha, the information ratio, and the Sortino ratio. In general, all of these performance measures evaluate excess return over some form of risk. It would be beneficial to memorize these measures of performance because they are popular concepts on the exam.

MODULE 5.1: MODERN PORTFOLIO THEORY AND THE CAPITAL MARKET LINE

Modern Portfolio Theory

LO 5.a: Explain MPT and interpret the Markowitz efficient frontier.

Due to abundance of market data, market risk has attracted significant interest from academics since the 1950s. As a result, numerous market risk models have since been developed. The criterion for a good market model is that it must have acceptable explanatory power without being unnecessarily complex.

One of the most notable market risk researchers was Harry Markowitz. He laid the foundation for modern portfolio theory in the early 1950s. Markowitz's portfolio theory makes the following assumptions:

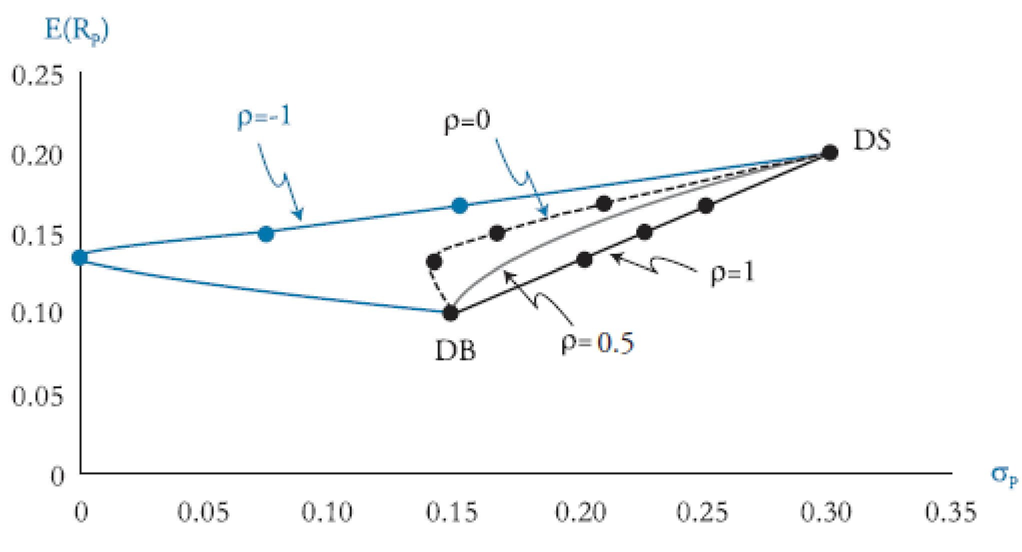
- *Returns are normally distributed*. This means that, when evaluating utility, investors only consider the mean and the variance of return distributions. They ignore deviations from normality, such as skewness or kurtosis (we will review those concepts in Book 2).

- *Investors are rational and risk-averse*. Markowitz defines a rational investor as someone who seeks to maximize utility from investments. Furthermore, when presented with two investment opportunities at the same level of expected risk, rational investors always pick the investment opportunity which offers the highest expected return.
- *Capital markets are perfect*. This implies that investors do not pay taxes or commissions. They have unrestricted access to all available information and perfect competition exists among the various market participants.

Because investors are risk-averse, they strive to minimize the risk of their portfolios for a given level of target return. This could be achieved by investing in multiple assets which are not perfectly correlated with each other (i.e., where their correlation coefficients, ρ, are less than 1).

While portfolio returns are calculated as weighted averages of individual asset returns, portfolio variances depend on the correlations among assets. A correlation of +1 offers no diversification benefits and results in portfolio variance being a weighted average of individual variances (solid black line DB-DS in Figure 5.1). When correlation is less than 1, diversification occurs and portfolio variance declines below the weighted average of individual variances. The lower the correlation, the greater the benefit becomes. With perfect negative correlation (ρ = −1), it is indeed possible to structure a portfolio with zero variance (i.e., a synthetic risk-free asset [y-intercept of blue curve in Figure 5.1]). We will further explore the mathematics of covariance and correlation in Book 2.

Figure 5.1: Effects of Correlation on Portfolio Risk



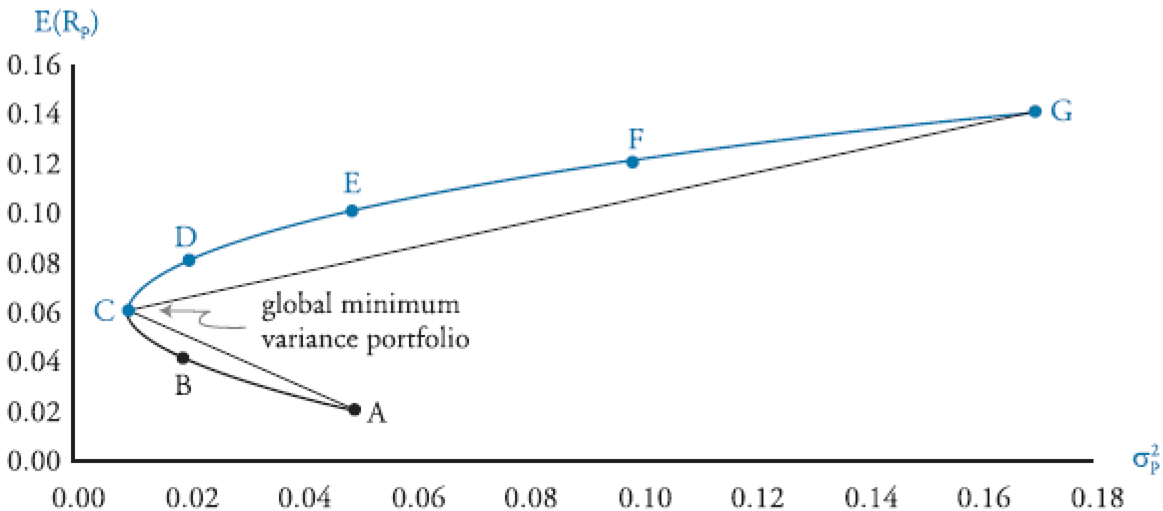
By holding a sufficiently large, diversified portfolio, investors are able to reduce, or even eliminate, the amount of company-specific (i.e., idiosyncratic) risk inherent in each individual security. Examples of company-specific risks include accounting fraud, cyber attacks, loss of key personnel, or any other issue which affects a specific company, without affecting the rest of the market. By holding a well-diversified portfolio, the importance of events affecting individual stocks in the portfolio is diminished, and the portfolio becomes mostly exposed to general market risk. It follows this pattern because when investors can diversify at low- or no-cost, they must not expect to receive compensation for unnecessary

exposure to company-specific risk given that it's diversifiable. The compensation they receive must be exclusively determined by their exposure to market risk.

The Efficient Frontier

Rational investors maximize portfolio return per unit of risk. Plotting all those maximum returns for various risk levels produces the **efficient frontier**, which is represented by the blue curve passing through C-D-E-F-G, shown in Figure 5.2.

Figure 1.1: Loss Categories



Point C is known as the **global minimum variance portfolio** because it is the efficient portfolio offering the smallest amount of total risk. Point C is, therefore, the leftmost point of the efficient frontier. Points A and B lie on the so-called **portfolio possibilities curve**, which is an extension of the efficient frontier below the global minimum variance portfolio, C. However, points A and B (or any other points below the efficient frontier) are considered inefficient because there is always a portfolio directly above them on the efficient frontier offering a higher return for the same amount of total risk. In general, any portfolio below the efficient frontier is, by definition, inefficient, whereas any portfolio above the efficient frontier is unattainable. In the absence of a risk-free asset, the only efficient portfolios are the portfolios on the efficient frontier. Investors choose their position on the efficient frontier depending on their relative risk aversion. A risk seeker may choose to hold Portfolio G whereas another investor seeking lower risk may choose to hold Portfolio D.

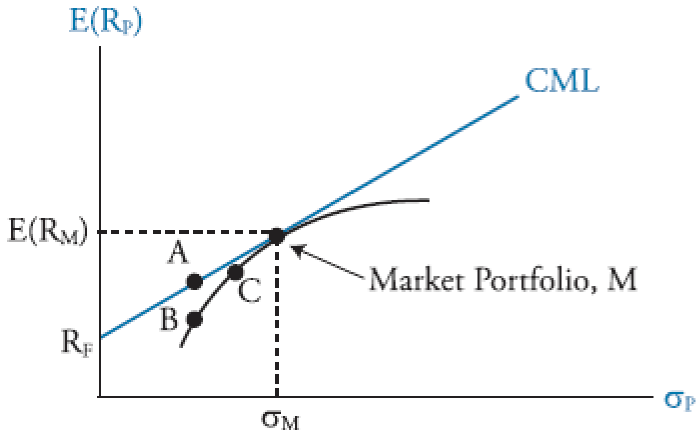
The Capital Market Line (CML)

LO 5.d: Interpret and compare the capital market line and the security market line.

So far in our analysis, we have only considered risky portfolios. The next step is to introduce a risk-free asset. A common proxy used for the risk-free asset is the U.S. Treasury bill (T-bill). Investors will combine the risk-free asset with a specific efficient portfolio that will maximize their risk-adjusted rate of return. Thus, investors obtain a line tangent to the efficient frontier whose y-intercept is the risk-free rate of return (as shown in Figure 5.3). Assuming investors have identical expectations regarding expected returns, variances/standard deviations, and covariances/correlations (i.e., homogenous

expectations), there will only be one tangency line, which is referred to as the **capital market line (CML).**

Figure 5.3: Capital Market Line



Because it is assumed there is only one CML, it follows that there is only one tangency portfolio, which, by definition, becomes the **market portfolio**. We can think of the market portfolio as the portfolio containing all risky asset classes in the world. In practice, a stock market index is often used as a proxy for the market portfolio, such as the S&P 500. All investors hold some combination of the risk-free asset and the market (tangency) portfolio, depending on their desired amount of total risk and return. For example, a more risk-averse investor may invest some of his money in the risk-free asset with the remainder invested in the market (i.e., his investment may be located at point A in Figure 5.3). At any point to the left of M, investors are lending at the risk-free rate because some of their money is invested in Treasuries, whereas at points to the right of M, they are borrowing at the risk-free rate (i.e., using leverage to magnify their investment in the market portfolio).

The equation of the CML is:

$$E(R_P) = R_F + \left[\frac{E(R_M) - R_F}{\sigma_M}\right]\sigma_P$$

The slope of the CML is equal to the *Sharpe measure*, which we will examine later in this reading.

PROFESSOR'S NOTE

The security market line (SML) will be discussed in Module 5.2, LO 5.b.

MODULE QUIZ 5.1

1. At a recent analyst meeting at Invest Forum, analysts Michelle White and Ted Jones discussed the use of the capital market line (CML). White states that the CML assumes that investors hold two portfolios: (1) a risky portfolio of all assets weighted according to their relative market value capitalizations; and (2) the risk-free asset. Jones states that the CML is useful in determining the required rate of return for individual securities. Are White and Jones's statements correct?
   A. Only Jones's statement is correct.
   B. Only White's statement is correct.

C. Both statements are correct.
D. Neither statement is correct.

MODULE 5.2: DERIVING AND APPLYING THE CAPITAL ASSET PRICING MODEL

The Capital Asset Pricing Model (CAPM)

LO 5.c: Describe the assumptions underlying the CAPM.

The **capital asset pricing model (CAPM)** was developed by William Sharpe and John Lintner in the 1960s. It builds on the ideas of modern portfolio theory and the CML in that investors are assumed to hold some combination of the risk-free asset and the market portfolio. Its key assumptions are:

- *Information is freely available*.
- *Frictionless markets*. There are no taxes and commissions or transaction costs.
- *Fractional investments are possible*. Assets are infinitely divisible, meaning investors can take a large position as well as very small positions.
- *Perfect competition*. Individual investors cannot affect market prices through their buying and selling activity and are, therefore, viewed as price takers.
- *Investors make their decisions solely based on expected returns and variances*. This implies that deviations from normality, such as skewness and kurtosis, are ignored from the decision-making process.
- *Market participants can borrow and lend unlimited amounts at the risk-free rate*.
- *Homogenous expectations*. Investors have the same forecasts of expected returns, variances, and covariances over a single period.

Clearly, the CAPM makes a number of unrealistic assumptions. As with any other model, care must be taken when relying solely on the results from the CAPM.

Estimating and Interpreting Systematic Risk

LO 5.f: Interpret beta and calculate the beta of a single asset or portfolio.

The expected returns of risky assets in the market portfolio are assumed to only depend on their relative contributions to the market risk of the portfolio. The systematic risk of each asset represents the sensitivity of asset returns to the market return and is referred to as the asset's **beta**. Beta is computed as follows:

$$\beta_i = \frac{\text{covariance of Asset i's return with the market return}}{\text{variance of the market return}} = \frac{\text{Cov}_{i,M}}{\sigma_M^2} = \rho_{i,M} \times \frac{\sigma_i}{\sigma_M}$$

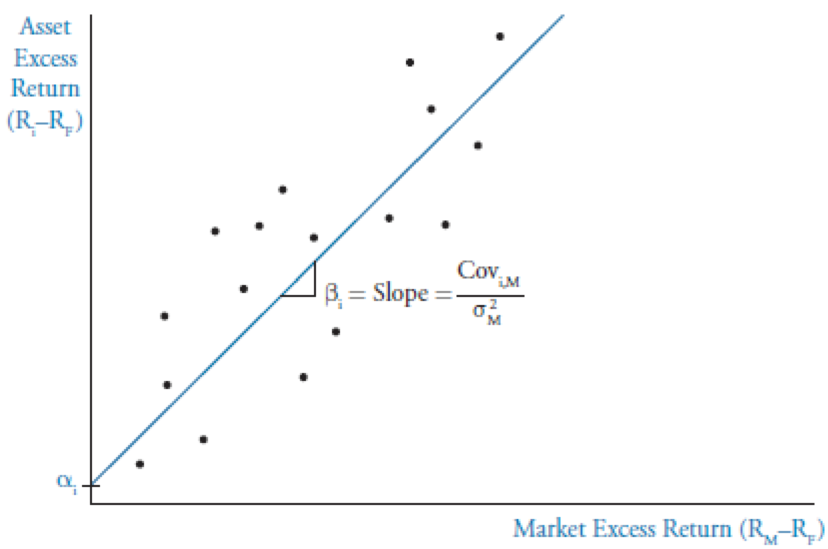
In the next section, we will demonstrate that the market beta is, by definition, equal to 1. Any security with a beta of 1 moves in a one-to-one relationship with the market. Consequently, any security with a beta greater than 1 moves by a greater amount (has more market risk) and is referred to as cyclical (e.g., luxury goods stock). Any security with a beta

below 1 is referred to as defensive (e.g., a utility stock). Cyclical stocks perform better during expansions whereas defensive stocks fare better in recessions.

> **EXAMPLE: Calculating an asset's beta**
>
> The standard deviation of the market return is estimated as 20%.
>
> 1. If Asset A's standard deviation is 30% and its correlation of returns with the market index is 0.8, what is Asset A's beta?
>
>   Using the formula: $\beta_i = \rho_{i,M}\frac{\sigma_i}{\sigma_M}$, we have: $\beta_i = 0.80\frac{0.30}{0.20} = 1.2$.
>
> 2. If the covariance of Asset A's returns with the returns on the market index is 0.048, what is the beta of Asset A?
>
>   Using the formula: $\beta_i = \frac{Cov_{i,M}}{\sigma_M^2}$, we have: $\beta_i = \frac{0.048}{0.2^2} = 1.2$.

In practice, we estimate beta by regressing asset returns against market returns. While regression is a concept discussed in Book 2, for the purposes of this reading, you can think of it as a mathematical estimation procedure that fits a line to a data plot. In Figure 5.4, we represent the excess returns on Asset *i* as the dependent variable and the excess returns on the market index as the independent variable. The **least squares regression line** is the line that minimizes the sum of the squared differences of the points from the line (this is what is meant by the line of *best fit*). The slope of this line is our estimate of beta.

Figure 5.4: Estimating Beta With Regression



Deriving the CAPM

LO 5.b: Understand the derivation and components of the CAPM.

A straightforward CAPM derivation recognizes that expected return

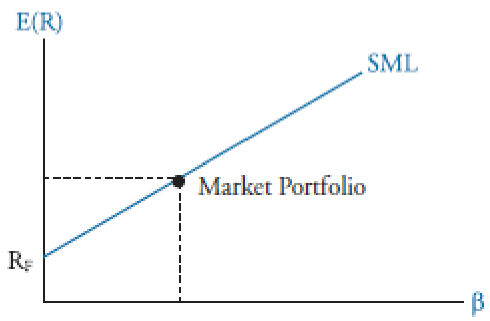
- only depends on beta (company-specific risk can be diversified away) and
- is a linear function of beta.

We therefore obtain the following equation, where expected return is explained as a linear function of beta with an intercept equal to *a* and slope equal to *m*:

$$E(R_P) = a + m \times \beta_P$$

The graphical depiction of the above equation is known as the **security market line (SML)**.

Figure 5.5: The Security Market Line



In Figure 5.5, the intercept occurs when beta is equal to 0 (i.e., when there is no systematic risk). The only asset with zero market risk is the risk-free asset, which is completely uncorrelated with market movements and offers a guaranteed return. Therefore, the intercept of the SML is equal to the risk-free rate of return, R_F .

To calculate the value of the slope we will need to know two points along the line. We already know the coordinates for the risk-free asset, which are (0, R_F). We also know the coordinates for the market portfolio, which must be (1, R_M) (i.e., the market portfolio has a return equal to the market return, by definition, and its systematic [beta] risk is equal to 1). The latter point can be easily demonstrated, remembering that the covariance of the returns of an asset with itself is equal to the variance (we will further explore the properties of covariance in Book 2):

$$\beta_M = \frac{Cov_{M,M}}{\sigma_M^2} = \frac{\sigma_M^2}{\sigma_M^2} = 1$$

We are now ready to calculate the slope of the SML as the *rise over run* of the line. This slope is known as the market risk premium (MRP) because it equals (R_M − R_F):

$$m = \frac{(R_M - R_F)}{(1-0)} = (R_M - R_F) = MRP$$

Recall that expected return is a linear function of beta:

$$E(R_P) = a + m \times \beta_P$$

Using substitution, we can now obtain the well-known CAPM equation:

$$E(R_i) = R_F + [E(R_M) - R_F]\beta_i$$

This implies that the expected return of an investment depends on the risk-free rate R_F , the MRP, $[R_M - R_F]$, and the systematic risk of the investment, β. The expected return, $E(R_i)$, can be viewed as the *minimum required return*, or the *hurdle rate*, that investors demand from an investment, given its level of systematic risk. Estimating hurdle rates accurately is very important. If investors use an inflated hurdle rate, they may incorrectly forgo valuable investment opportunities. If, on the other hand, the rate used is too low, investors may purchase overvalued assets.

LO 5.e: Apply the CAPM in calculating the expected return on an asset.

EXAMPLE: **Expected return on a stock**

Assume you are assigned the task of evaluating the stock of Sky-Air, Inc. To evaluate the stock, you calculate its required return using the CAPM. The following information is available:

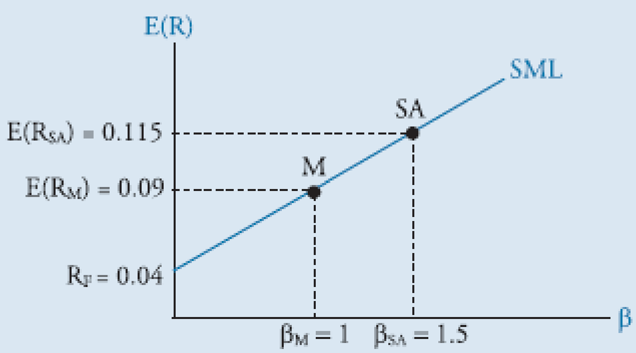
Expected market risk premium	5%
Risk-free rate	4%
Sky-Air beta	1.5

Using CAPM, **calculate** and **interpret** the expected return for Sky-Air.

Answer:

The expected return for Sky-Air is:

$$E(R_{SA}) = 0.04 + 1.5(0.05) = 0.115 = 11.5\%$$



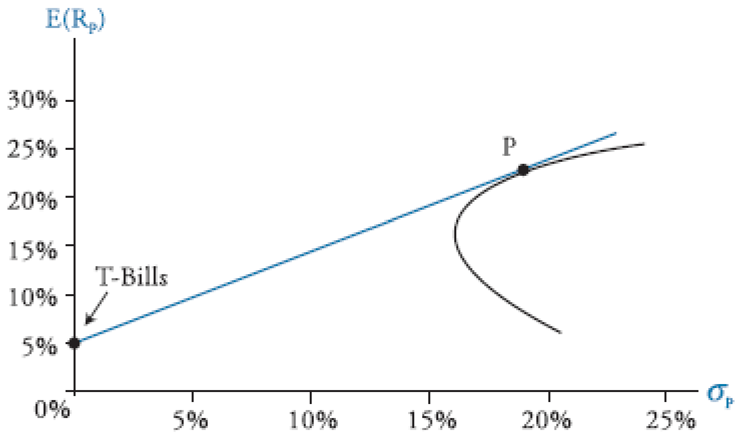
In this case, the hurdle rate is 11.5% (i.e., this is the minimum required return given the market risk of Sky-Air). If investors predict that the return will exceed 11.5%, then they should buy Sky-Air stock (stock is undervalued). However, if investors predict that the expected return will be less than 11.5%, then they should either shy away from Sky-Air stock or short the stock, if allowed to do so, because the stock is overvalued.

In the previous example, we calculated the required rate of return, which always lies on the SML. If an analyst determines that the expected return is different from the required rate of return implied by CAPM, then the security may be mispriced according to rational expectations. A mispriced security would not lie on the SML. In general:

- An overvalued security would have a required rate of return (computed by CAPM) that is higher than its expected return (computed by the analyst's valuation). An overvalued security would plot below the SML.
- An undervalued security would have a required rate of return (computed by CAPM) that is lower than its expected return (computed by the analyst's valuation). An undervalued security would plot above the SML.

MODULE QUIZ 5.2

Use the following graph to answer Question 1.



1. In the above mean-variance analysis, a risk analyst has combined the risk-free asset (T-bills) with Portfolio P. Portfolio P is least likely to:
   - A. be efficient.
   - B. have beta of 1.
   - C. lie on the security market line.
   - D. represent a 100% investment in the market portfolio.
2. Which of the following statements is most likely an assumption of the capital asset pricing model (CAPM)?
   - A. Investors only face capital gains taxes.
   - B. Investors' actions affect the prices of assets.
   - C. Transaction costs are constant across all assets.
   - D. Market participants can lend and borrow unlimited amounts at the risk-free rate.
3. Patricia Franklin makes buy and sell stock recommendations using the capital asset pricing model (CAPM). Franklin has derived the following information for the broad market and for the stock of the CostSave Company (CS):

Expected market risk premium	8%
Risk-free rate	5%
Historical beta for CS	1.50

Franklin believes that historical betas do not provide good forecasts of future beta, so therefore uses the following formula to forecast beta:

forecasted beta = 0.80 + 0.20 × historical beta

After conducting a thorough examination of market trends and the CS financial statements, Franklin predicts that the CS return will equal 10%. Franklin should derive which of the following CS required returns for CS and valuation decisions (undervalued or overvalued)?

	Valuation	CAPM required return
A.	Overvalued	8.3%
B.	Overvalued	13.8%
C.	Undervalue	8.3%
D.	Undervalued	13.8%

4. Albert Dreiden wants to estimate the expected return on the market. He believes that the stock of the Hobart Materials Company is fairly valued, and gathers the following information:

Expected return for Hobart	7.50%
Risk-free rate	4.50%
Beta for Hobart	0.80

Based on this information, the estimated expected return for the market portfolio is closest to:

A. 3.00%.
B. 3.75%.
C. 6.90%.
D. 8.25%.

MODULE 5.3: PERFORMANCE EVALUATION MEASURES

LO 5.g: Calculate, compare, and interpret the following performance measures: the Sharpe performance index, the Treynor performance index, the Jensen performance index, the tracking error, information ratio, and Sortino ratio.

It is important for portfolio managers to not only focus on raw returns but to also analyze the risk taken to generate those returns. In other words, portfolio managers must analyze risk-adjusted rates of return to evaluate the true performance of their portfolios given the amount of risk taken. We begin by analyzing three traditional performance measures:

- Sharpe performance index (SPI)
- Treynor performance index (TPI)
- Jensen's performance index (JPI)

In all three cases, for a given portfolio, the higher measure, the better the risk-adjusted return. Note that Sharpe and Treynor are very similar in that they both normalize the risk premium by dividing by a measure of risk.

Sharpe Performance Index

The Sharpe measure computes excess return (portfolio return in excess of the risk-free rate) per unit of total risk (as measured by standard deviation). Investors can apply the Sharpe measure to all portfolios because it uses total risk, and it is more widely used than the other two measures.

$$SPI = \left[\frac{E(R_P) - R_F}{\sigma_P}\right]$$

As previously mentioned, the slope of the CML is the Sharpe measure of the market. A portfolio with a Sharpe measure greater than the Sharpe measure of the market offers better risk-adjusted returns compared to the market. This inevitably assumes that markets are not always efficient, allowing managers to sometimes *beat the market*.

Treynor Performance Index

The Treynor measure is similar to the Sharpe measure in that both use the same numerator, the portfolio excess return. However, they differ in their calculation of the denominator. While the Sharpe measure uses total risk as measured by standard deviation, the Treynor measure uses systematic risk as measured by beta.

$$TPI = \left[\frac{E(R_P) - R_F}{\beta_P}\right]$$

As previously mentioned, well-diversified portfolios are only exposed to market risk, having diversified away idiosyncratic risk. Beta and TPI should therefore be more relevant metrics for well-diversified portfolios. On the other hand, poorly-diversified portfolios (i.e., portfolios containing few assets) will likely have an unnecessarily high standard deviation due to the presence of excessive company-specific risk.

Recall that the mathematical description of the SML is the CAPM, whose slope is the MRP:

$$E(R_i) = R_F + [E(R_M) - R_F]\beta_i$$

The slope of the SML can also be viewed as the Treynor measure of the market, or the MRP:

$$TPI_M = \left[\frac{E(R_M) - R_F}{\beta_M}\right] = \left[\frac{E(R_M) - R_F}{1}\right] = MRP$$

Jensen's Performance Index

Jensen's Performance Index, like Treynor, assumes investors are well-diversified and, therefore, uses beta rather than standard deviation as the relevant risk metric. Essentially, it compares the portfolio expected return to the CAPM required return. The difference between the two may be referred to as Jensen's alpha (α_P).

$$JPI = \alpha_P = E(R_P) - \{R_F + [E(R_M) - R_F]\beta_P\}$$

In equilibrium (the absence of mispricing), the portfolio expected return must equal the CAPM required return resulting in zero alpha. If Jensen's alpha is positive, this implies that the portfolio is undervalued and investors would be wise to buy or hold it. Jensen's alpha is most suitable for comparing portfolios that have the same level of systematic risk.

The Treynor measure and Jensen's alpha go hand in hand, in that superior performance implied by the Treynor measure automatically implies superior performance according to Jensen's alpha. However, relative rankings of portfolios may differ according to the two measures.

> EXAMPLE: **Calculating performance measures**
>
> For a portfolio of 10 stocks, assume that the portfolio's expected return is 14% with a standard deviation of 25%. The beta of the portfolio is 1.1. The expected return of the market is 12.5% with a standard deviation of 20.2%. The risk-free rate is 2.6%. **Calculate** Sharpe, Treynor, and Jensen's alpha for the portfolio of stocks. **Compare** the above measures to each measure for the market.
>
> **Answer:**
>
> $$SPI_P = \left[\frac{E(R_P) - R_F}{\sigma_P}\right] = \left[\frac{0.14 - 0.026}{0.25}\right] = 0.456$$
>
> $$TPI_P = \left[\frac{E(R_P) - R_F}{\beta_P}\right] = \left[\frac{0.14 - 0.026}{1.1}\right] = 0.1036$$

$JPI_P = \alpha_P = 0.14 - [0.026 + (0.125 - 0.026)(1.1)] = 0.0051$

We can now compare the above measures to Sharpe, Treynor, and Jensen's alpha of the market:

$$SPI_M = \left[\frac{E(R_M) - R_F}{\sigma_M}\right] = \left[\frac{0.125 - 0.026}{0.202}\right] = 0.49$$

$$TPI_M = \left[\frac{E(R_M) - R_F}{\beta_M}\right] = \left[\frac{0.125 - 0.026}{1.0}\right] = 0.099$$

$$JPI_M = \alpha_P = 0.125 - [0.026 + (0.125 - 0.026)(1.0)] = 0.00$$

An alternative approach to evaluating portfolios is to calculate excess return relative to a target return or a benchmark portfolio return. In the following section, we will review three such measures:

- Tracking error
- Information ratio
- Sortino ratio

Tracking Error

If a manager is trying to earn a return higher than the market portfolio or any other reference or benchmark, the difference will have some variability over time. In other words, even if the manager is successful in generating a positive alpha, the alpha will vary over time. **Tracking error** is the term used to describe the standard deviation of the difference between the portfolio return and the benchmark return. This source of variability is another source of risk to use in assessing the manager's success.

$$\text{tracking error} = \sqrt{\frac{\sum(R_P - R_B)^2}{n - 1}}$$

PROFESSOR'S NOTE

If you are asked to calculate tracking error on the exam, it would most likely amount to no more than obtaining the standard deviation using the relevant function on your calculator. We will review this computation in detail in Book 2. Also, note that even though the earlier definition of tracking error is typically how it's defined, some practitioners refer to tracking error simply as the difference between portfolio returns and benchmark returns: $R_P - R_B$.

Information Ratio

The **information ratio (IR)** divides the portfolio expected return in excess of the benchmark expected return by the tracking error:

$$IR = \frac{E(R_P - R_B)}{\text{tracking error}} = \frac{\text{active return}}{\text{active risk}}$$

PROFESSOR'S NOTE

Some practitioners refer to the numerator as active return and the denominator as active risk. The definition of tracking error (active risk) for the denominator of the IR is the same as the first definition provided earlier—the standard deviation of the difference between the portfolio return and the benchmark return.

Sortino Ratio

The **Sortino ratio** is reminiscent of the Sharpe measure except for two changes. First, we replace the risk-free rate with a *minimum acceptable return*, denoted R_{MIN} . This return could be determined by the needs of the investor or it can sometimes be set equal to the risk-free rate. Second, we replace standard deviation with *downside deviation*:

$$\text{Sortino} = \frac{R_P - R_{MIN}}{\text{downside deviation}}$$

Downside deviation is a type of semi-standard deviation. It measures the variability of only those returns that fall below the minimum acceptable return. Returns higher than R_{MIN} are ignored from the calculation of downside deviation as they are not considered risky as far as the desired returns of our investor are concerned.

PROFESSOR'S NOTE

It is unlikely that you will be asked to calculate downside deviation, so focus on being able to compute the Sortino ratio given R_P , R_{MIN}, and downside deviation.

EXAMPLE: **Calculating the information ratio and the Sortino ratio**

An active portfolio manager is trying to beat the FTSE 100. The expected returns of the active portfolio and the FTSE 100 are 15% and 12%, respectively, while the tracking error is 9%. The minimum acceptable return is 4% and the downside deviation is 7%. **Compute** the information ratio and the Sortino ratio.

Answer:

$$\text{IR} = \frac{E(R_P - R_B)}{\text{tracking error}} = \frac{0.15 - 0.12}{0.09} = 0.33$$

$$\text{Sortino} = \frac{R_P - R_{MIN}}{\text{downside deviation}} = \frac{0.15 - 0.04}{0.07} = 1.57$$

MODULE QUIZ 5.3

1. For a given portfolio, having a Treynor measure greater than the market but a Sharpe measure that is less than the market would most likely indicate the portfolio is:
   A. not well-diversified.
   B. generating a negative alpha.
   C. borrowing at the risk-free rate.
   D. not borrowing at the risk-free rate.
2. With respect to performance measures, the use of the standard deviation of portfolio returns is a distinguishing feature of:
   A. the beta measure.
   B. the Jensen's alpha.
   C. the Sharpe measure.

D. the Treynor measure.

3. For a given portfolio, the expected return is 9% with a standard deviation of 16%. The beta of the portfolio is 0.8. The expected return of the market is 12% with a standard deviation of 20%. The risk-free rate is 3%. The portfolio's alpha is:
   A. −1.2%.
   B. −0.6%.
   C. +0.6%.
   D. +1.2%.

4. Advanced Quantitative Models global equity fund has averaged a return of 12.5% per year over the last 10 years. The benchmark average return over the same period was 11% per year. The risk-free rate of return during the same period averaged 3.5%. The standard deviation of the fund's return is 16.15%, and the tracking error is 10.5%. What is the information ratio (IR) for the fund?
   A. 0.14.
   B. 0.95.
   C. 1.05.
   D. 1.19.

5. Given the following information:

Risk-free rate	4%
Minimum acceptable return	6%
Benchmark return	10%
Expected return on portfolio	12%
Expected return on market	9%
Beta	1.25
Standard deviation (portfolio)	7.3%
Downside deviation (portfolio)	8.2%

   What is the Sortino ratio of the portfolio?
   A. 0.24.
   B. 0.73.
   C. 0.82.
   D. 0.98.

KEY CONCEPTS

LO 5.a

Rational investors seek to maximize return per unit of risk and, therefore, absent a risk-free asset, they will hold a portfolio on the efficient frontier. To reduce total risk, investors diversify across multiple investments. A sufficiently large portfolio will have eliminated company-specific (idiosyncratic) risk and will only be exposed to market risk.

LO 5.b

To derive the capital asset pricing model (CAPM), we must recognize that

- expected return only depends on beta because company-specific risk can be diversified away, and
- expected return is a linear function of beta.

The capital asset pricing model (CAPM) equation is:

$$E(R_i) = R_F + [E(R_M) - R_F]\beta_i$$

The beta of the market is equal to 1, and the slope of the security market line (SML) is equal to the market risk premium (MRP). The SML is the graphical depiction of the CAPM.

LO 5.c

The capital asset pricing model (CAPM) makes the following assumptions:

- Information is freely available.
- There are no taxes and commissions.
- Fractional investments are possible.
- Market participants can borrow and lend at the risk-free rate.
- Individual investors cannot affect market prices.
- Investors have the same forecasts of expected returns, variances, and covariances.

LO 5.d

The capital market line (CML) linearly combines the risk-free asset with the tangency portfolio of the efficient frontier. Given the assumption of homogenous expectations, the tangency portfolio becomes the market portfolio. All investors are assumed to hold some combination of the risk-free asset and the market portfolio. The equation of the CML is:

$$E(R_P) = R_F + \left[\frac{E(R_M) - R_F}{\sigma_M}\right]\sigma_P$$

The slope of the CML is the Sharpe performance index.

LO 5.e

The expected return for an asset can be computed using the following formula, given the risk-free rate, the market risk premium (MRP), and an asset's beta:

$$E(R_i) = R_F + [E(R_M) - R_F]\beta_i$$

The MRP is the return of the market in excess of the risk-free rate.

LO 5.f

Beta can be estimated as the slope from a linear regression of stock returns against market returns. It is the sensitivity of stock returns to market movements. The following formulas can be used to calculate beta:

$$\beta_i = \frac{\text{covariance of Asset i's return with the market return}}{\text{variance of the market return}} = \frac{Cov_{i,M}}{\sigma_M^2} = \rho_{i,M} \times \frac{\sigma_i}{\sigma_M}$$

LO 5.g

Risk-adjusted performance measures include: the Sharpe performance index (SPI), the Treynor performance index (TPI), and Jensen's alpha. Both Treynor and Jensen's alpha are based on beta, whereas Sharpe is based on standard deviation:

$$SPI = \left[\frac{E(R_P) - R_F}{\sigma_P}\right]$$

$$TPI = \left[\frac{E(R_P) - R_F}{\beta_P}\right]$$

$$JPI = \alpha_P = E(R_P) - \{R_F + [E(R_M) - R_F]\beta_P\}$$

Three relative performance metrics include: tracking error, the information ratio (IR), and the Sortino ratio:

$$\text{tracking error} = \sqrt{\frac{\sum(R_P - R_B)^2}{n - 1}}$$

$$IR = \frac{E(R_P - R_B)}{\text{tracking error}} = \frac{\text{active return}}{\text{active risk}}$$

$$\text{Sortino} = \frac{R_P - R_{MIN}}{\text{downside deviation}}$$

ANSWER KEY FOR MODULE QUIZZES

Module Quiz 5.1

1. **B** The CML assumes all investors have identical expectations and all use mean-variance analysis, implying that they all identify the same risky tangency portfolio (the *market portfolio*) and combine that risky portfolio with the risk-free asset when creating their portfolios. Because all investors hold the same risky portfolio, the weight on each asset must be equal to the proportion of its market value to the market value of the entire portfolio. Therefore, White is correct. The CML is useful for determining the rate of return for efficient portfolios, but it cannot be used to determine the required rate of return for inefficient portfolios or individual securities. The capital asset pricing model (CAPM) is used to determine the required rate of return for inefficient portfolios and individual securities. Therefore, Jones is incorrect. (LO 5.d)

Module Quiz 5.2

1. **C** The line connecting the risk-free rate with the tangency (market) portfolio is referred to as the capital market line. The market portfolio has a beta of 1, by definition, and lies on the efficient frontier. Had risk been measured on the graph with beta, the graph would represent the security market line. (LO 5.b)

2. **D** The CAPM assumes unlimited borrowing and lending at the risk-free rate. Additionally, CAPM assumes no taxes, no transaction costs, and that investor actions do not affect market prices. (LO 5.c)

3. **B** The CAPM equation is:

$$E(R_i) = R_F + \beta_i[E(R_M - R_F)]$$

Franklin forecasts the beta for CostSave as follows:

beta forecast = 0.80 + 0.20 (historical beta)

beta forecast = 0.80 + 0.20(1.50) = 1.1

The CAPM required return for CostSave is then:

0.05 + 1.1(0.08) = 13.8%

Note that the market premium, $E(R_M) - R_F$, is provided in the question (8%).

Franklin should decide that the stock is overvalued because she forecasts that the CostSave return will equal only 10%, whereas the required return (minimum acceptable return) is 13.8%. (LO 5.e)

4. **D** The capital asset pricing model (CAPM) equation is:

$$E(R_i) = R_F + \beta_i[E(R_M - R_F)]$$

Using the given information, we can solve for the expected return for the market portfolio as follows:

$7.50\% = 4.50\% + 0.80[E(R_M) - 4.50\%]$

$E(R_M) = [(7.50\% - 4.50\%) / 0.80] + 4.50\% = 8.25\%$

Based on the information given and using the CAPM, the expected return on the market is 8.25%. (LO 5.e)

Module Quiz 5.3

1. **A** Low diversification can produce a Treynor measure greater than the Sharpe measure because it will likely increase the standard deviation of the portfolio's returns, thus decreasing the Sharpe measure. Using margin is not directly related to the risk-adjusted performance, because adjusting for risk removes the effect of leverage. A Treynor measure greater than the market Treynor would result in a positive alpha (not a negative alpha). (LO 5.g)

2. **C** The Sharpe measure is the portfolio return minus the risk-free rate divided by the standard deviation of the return. The Treynor and Jensen measures use beta as the measure of risk. The answer *beta measure* is a nonsensical choice for this question. (LO 5.g)

3. **A** The alpha is 9% − [3% + 0.8 × (12% − 3%)] = −1.2%. (LO 5.g)

4. **A** IR = (12.5 − 11) / 10.5 = 0.14. (LO 5.g)

5. **B** Sortino ratio = (portfolio return – minimum acceptable return) / downside deviation

= (0.12 – 0.06) / 0.082 = 0.7317

(LO 5.g)

The following is a review of the Foundations of Risk Management principles designed to address the learning objectives set forth by GARP®. Cross-reference to GARP FRM Part I Foundations of Risk Management, Chapter 6.

Reading 6

THE ARBITRAGE PRICING THEORY AND MULTIFACTOR MODELS OF RISK AND RETURN

Study Session 2

EXAM FOCUS

The relationship between risk and return is one of the most important concepts in finance. The capital asset pricing model (CAPM) asserts that the expected return on any asset is solely determined by its exposure to the market portfolio. Recall from the previous reading that the risk exposure in the CAPM is known as beta. In contrast, arbitrage pricing theory (APT) asserts that expected returns are determined by exposures to multiple factors that are linked to the macroeconomy. The risk exposures in APT are known as factor betas. For the exam, be able to calculate expected returns using single-factor and multifactor models. Also, understand the Fama and French three-factor version of a multifactor model. In addition, be able to describe how to use a multifactor approach to construct a hedged portfolio.

MODULE 6.1: MULTIFACTOR MODEL ASSUMPTIONS AND INPUTS

Arbitrage Pricing Theory

LO 6.a: Explain the Arbitrage Pricing Theory (APT), describe its assumptions, and compare the APT to the CAPM.

Investors have historically thought about the expected return for an investment through the filter of the **capital asset pricing model (CAPM)**. This model captures a linear relationship between a financial asset and a single index (e.g., S&P 500 Index). Using CAPM, risk is modeled through the beta (or factor exposure) to this single index. In 1976, economics professor Steven Ross proposed an alternative risk modeling tool called **arbitrage pricing theory (APT)**.[1] This newer approach is a type of multifactor model that measures the linear relationship between a financial asset and multiple risk factors, which includes one or more financial indices (e.g., S&P 500 Index, bond index, or commodity index) and multiple macroeconomic variables (e.g., GDP, interest rate metrics, production measures, employment variables).

In a classic sense, the term *arbitrage* refers to the simultaneous buying and selling of two securities to capture a perceived abnormal price difference between the two assets. In the context of APT, this term simply refers to a model that measures expected return relative to multiple risk factors. In fact, APT assumes that there are no available arbitrage opportunities, and that if one does exist, it will very quickly evaporate due to the trading actions of market participants.

According to arbitrage pricing theory, the expected return for security *i* can be modeled as shown here. The idea is to model systematic risk on a more granular level using a series of risk factors.

$$R_i = E(R_i) + \beta_1 F_1 + \beta_2 F_2 + \ldots + \beta_k F_k + e_i$$

where:

R_i = the actual return on stock *i*
$E(R_i)$ = the expected return on stock *i*
β_1 = the beta (factor sensitivity) for factor 1
F_1 = the first in a series of risk factors that could add return deviation from the expected return
β_k = the beta (factor sensitivity) for factor k
F_k = the last in a series of risk factors that could add return deviation from the expected return
e_i = a random error term that accounts for company-specific (idiosyncratic) risk

Every mathematical model is based on a series of assumptions. Arbitrage pricing theory has very simplistic assumptions, including the following:

1. Market participants are seeking to maximize their profits.
2. Markets are frictionless (i.e., no barriers due to transaction costs, taxes, or lack of access to short selling).
3. There are no arbitrage opportunities, and if any are uncovered, then they will be very quickly exploited by profit-maximizing investors.

One element, which is both good and bad, is that APT does not specify the multiple factors to include in the analysis. This provides analysts with tremendous flexibility. However, if an investor is looking for a clear-cut and direct calculation, then APT might not be the best fit. Factors need to be checked on a periodic basis and factor sensitivities (betas) need to also be updated on a regular basis because financial markets are dynamic. Ultimately, there is no one-size-fits-all approach for determining the macroeconomic factors used in an APT model, but Chen, Roll, and Ross propose the following four factors as one way to structure an APT model[2]:

- The spread between short-term and long-term interest rates (i.e., the yield curve)
- Expected versus unexpected inflation
- Industrial production
- The spread between low-risk and high-risk corporate bond yields

The core of the APT model is to find a combination of granular risk factors, such as those presented, that more closely predict the return of a financial asset. In this model, arbitrage is not an expected opportunity because the model is adjusted to account for macroeconomic variables that might explain the current pricing for a given stock. This does not mean that

the actual stock returns will not deviate from APT pricing (it very well may). This is the influence of company-specific risk factors. An analyst would be wise to buy a security whose market price drifts lower than APT would suggest (due to unexpected factors) and to potentially short a stock whose price is too much higher than APT's calculated return. This logic introduces model risk and also the need to periodically update model coefficients to ensure robustness.

Multifactor Model Inputs

LO 6.b: Describe the inputs (including factor betas) to a multifactor model and explain the challenges of using multifactor models in hedging.

The inputs into a multifactor model can be best understood by considering its equation, which can be seen as follows for stock *i*:

$$R_i = E(R_i) + \beta_1 F_1 + \beta_2 F_2 + \ldots \beta_k F_k + e_i$$

The first input is the expected return for the stock in question. This type of multifactor model will then offer a series of adjustments that attempt to capture known variables that would influence the returns of a stock (or portfolio). A beta (factor sensitivity) is needed for each variable included in the model, and a value is needed for each factor as well. The error term (e_i) represents firm-specific return that is otherwise unexplained by the model. This idiosyncratic risk could come from factors that are correlated with the stock's return but are excluded from the analysis. It could come from randomness and potentially from irrational market behavior. It could also result from unexpected firm-specific events such as labor strikes, natural disasters, or tariff uncertainty. Because firm-specific events are random, the expected (i.e., default) value for the error term is zero.

A multifactor model could include any number of variables that an analyst desires to consider. They could be macroeconomic variables, or they could be firm attributes (e.g., P/E multiples, revenue trends, historical returns). Consider an example where an analyst tests a stock's sensitivity to deviations from consensus expectations in quarterly GDP releases. The factor for GDP could be expressed as F_{GDP} and the beta (also known as the *factor loading* or the *factor sensitivity*) for GDP might be 2.0. If consensus GDP is 3.2%, but the actual value comes in as 2.2%, then

the deviation is −0.01 (i.e., −1%). With a GDP beta (β_{GDP}) of 2.0, then we would expect the stock to decline by 2% (double the factor's movement due to the beta of 2.0).

PROFESSOR'S NOTE

Challenges of hedging exposures when using multifactor models will be explained in Module 6.2, LO 6.d.

MODULE QUIZ 6.1

1. Which of the following statements is correct regarding arbitrage pricing theory (APT)?
   A. APT uses a pre-established series of variables to calculate expected returns.
   B. APT provides more flexibility than traditional CAPM-based models.
   C. APT relies on a strict series of assumptions.
   D. APT is constrained to a five-factor model.

2. Which of the following statements regarding the inputs involved with a multifactor model is correct?
    A. The factors included in a multifactor model are very rigid.
    B. Factor betas describe how much the relationship is amplified between the stock under analysis and the respective factor.
    C. Analysts must include only economic variables as the factors in a multifactor model.
    D. Factor betas must be positive values.

MODULE 6.2: APPLYING MULTIFACTOR MODELS

Calculating Expected Returns

LO 6.c: Calculate the expected return of an asset using a single-factor and a multifactor model.

The number of factors to include in a model should be as small as possible, yet still capture the priced sources of systematic (nondiversifiable) risk. The simplest versions consist of just one macro factor (a **single-factor model**). Consider the differences between a single-factor and a multifactor model using a two-step example.

First, let's examine a single-factor option for the common stock of HealthCare Inc. (HCI). Actual returns are measured using a single-factor model that captures the impact of GDP surprises (unexpected percentage changes denoted by GDP*). The formula for this relationship follows:

$$R_{HCI} = E(R_{HCI}) + \beta_{GDP*}F_{GDP*} + e_{HCI}$$

The following data expands this single-factor example:

- The expected return for HCI is 10%.
- The factor beta for GDP surprises is 2.0.
- The expected GDP growth rate is 3.2%.

Considering the factor beta, we can deduce that the expected returns for HCI are strongly influenced by GDP surprises. This beta suggests a 200% sensitivity. Therefore, the stock price is estimated to change by 2% if the GDP surprise is 1%.

What would this single-factor model prediction be if GDP were actually 2.6% and not the original consensus forecast of 3.2%? The GDP surprise factor is −0.60% (= 2.6% − 3.2%). The formula would suggest that HCI's stock return should be 8.8%:

$$R_{HCI} = E(R_{HCI}) + \beta_{GDP*}F_{GDP*} + e_{HCI}$$
$$R_{HCI} = 0.10 + 2.0(-0.006) + e_{HCI} = 0.088 = 8.8\%$$

Perhaps HCI's actual return was 8.25%. Any deviation from the 8.8% value represents either company-specific risk or systematic risk exposure that is not captured by the single-factor model. A multifactor model enables analysts to include the systematic risk exposure of multiple factors. Maybe surprises in consumer sentiment (CS*) is also a big influencer for HCI's returns. Consider the following multifactor model:

$$R_{HCI} = E(R_{HCI}) + \beta_{GDP*}F_{GDP*} + \beta_{CS*}F_{CS*} + e_{HCI}$$

The information below is added to the single-factor model data:

- The factor beta for CS surprises is 1.5.
- The expected CS growth rate is 1.0%.

If an updated measure of CS presents a growth rate of 0.75%, then the CS surprise factor is −0.25% (= 0.75% − 1.0%) and HCI's stock price should be 8.43%:

$$R_{HCI} = E(R_{HCI}) + \beta_{GDP*}F_{GDP*} + \beta_{CS*}F_{CS*} + e_{HCI}$$
$$R_{HCI} = 0.10 + 2.0(-0.006) + 1.5(-0.0025) + e_{HCI} = 0.0843 = 8.43\%$$

The multifactor model predicts a value of 8.43%, which is much closer to the actual result of 8.25%. This multifactor model is capturing more of the systematic influences. An analyst would likely keep exploring to find a third or fourth factor that would get them even closer to the actual result. Once the proper risk factors have been included, the analyst will be left with company-specific risk (e_i) that can be diversified away.

PROFESSOR'S NOTE

Both the factors and the beta exposures will need to be updated and verified on a periodic basis because these elements change dynamically.

Accounting for Correlation

Arbitrage pricing theory is an application of a multifactor model that serves as an alternative to CAPM. This theory relies on the use of a **well-diversified portfolio**. A portfolio is well diversified if financial assets are mixed with other assets that have sufficient correlation differences to expel much of the company-specific risk (i.e., nonsystematic risk, idiosyncratic risk). A well-diversified portfolio will then be left with market-linked risk (i.e., systematic risk), which is measured by a beta coefficient.

We understand that diversification is enhanced when correlations between portfolio assets is low. Logic points to higher correlations when constituent assets in a portfolio come from the same asset class and lower correlations when member assets are drawn from different asset classes (e.g., commodities, real estate, industrial firms, utilities). The presence of multiple asset classes will result in a divergent list of factors that might impact the expected returns for a stock. Multifactor models are ideal for this form of analysis.

The main conclusion of APT is that expected returns on well-diversified portfolios are proportional to their factor betas. However, we cannot conclude that the APT relationship will hold for *all* securities. For example, if the APT relationship is violated for one security in the portfolio, then its effect will be too small to produce meaningful arbitrage opportunities for the portfolio. Therefore, we can conclude that the APT relation can hold for well-diversified portfolios even if it does not hold for all securities in the portfolio. But, the APT relationship must hold for nearly all securities in a well-diversified portfolio, or else arbitrage opportunities will become available for the portfolio. Therefore, we can conclude that the APT relationship must hold for nearly all securities.

Hedging Exposure to Multiple Factors

LO 6.d: Explain how to construct a portfolio to hedge exposure to multiple factors.

The granular exposures captured by multifactor models enable a unique hedging opportunity. Using calculated factor sensitivities, an investor can build **factor portfolios**, which retain some exposures and intentionally mitigate others through targeted portfolio allocations. Consider the following example with a series of three well-diversified portfolio as:

	Portfolio 1	Portfolio 2	Portfolio 3
GDP surprise factor sensitivity (β_{GDP*})	0.50	0.50	
Consumer sentiment surprise factor sensitivity (β_{CS*})	0.30		0.30
Unemployment surprise factor (β_{JOBS*})		0.25	
Manufacturing sector surprise factor (β_{ISM*})			1.25

Suppose that an investor wishes to mitigate all exposure to GDP surprise risk. That investor could find a financial asset (or portfolio) that is correlated with GDP surprise and has an equal factor sensitivity of 0.50. In this example, an investor could take a long position in Portfolio 1 and a short position in Portfolio 2. Doing so would result in a zero beta for GDP surprise, but it would retain a 0.30 beta for consumer sentiment surprise and add a −0.25 beta (because the position is held short) to unemployment surprise. It is possible to find a financial asset that only has an equal factor exposure to the single variable of GDP surprise. In such a circumstance, the investor could neutralize the GDP surprise exposure and not add any other new exposures.

An investor could also decide to be long Portfolio 1 and short Portfolio 3, which would neutralize the consumer sentiment exposure while retaining GDP surprise and adding manufacturing surprise. A third option would be to find derivatives that could hedge the 0.50 beta exposure to GDP surprise and the 0.30 beta exposure to consumer sentiment surprise. In this instance, an investor could form a hedged portfolio (Portfolio H) which has a 50% position in a derivative with exposure to only GDP surprise, a 30% position in a derivative with exposure to only consumer sentiment surprise, and the remaining 20% in the risk-free asset. An investor could take a long position in Portfolio 1 and a short position in Portfolio H. This action would effectively mitigate all exposure to both GDP surprise and consumer sentiment surprise.

An investor might engage in this fully hedged process to exploit a perceived arbitrage opportunity. Perhaps Portfolio 1 has an expected return of 12% and the hedged portfolio has an expected return of 10%. Taking equal long and short positions in these two portfolios will result in a potential 2% arbitrage profit [12% (long) − 10% (short)]. Alternatively, if the hedged portfolio instead had a 14% expected return, then the investor could take a long position in Portfolio H and a short position in Portfolio 1. This action would accomplish the same goal of neutralizing factor sensitivities while isolating the perceived 2% arbitrage opportunity.

One challenge of hedging exposures when using multifactor models is the potential for error. Because this hedging process is based on the calculated model, there will always be an element of model risk. For example, what if the factor sensitivities have changed or what if different factors are better descriptors for a portfolio? Another challenge arises if the hedging strategy is either rebalanced too infrequently or too often. Trading costs from

frequent rebalancing could erode profits, and infrequent rebalancing could risk undesired exposures as relationships dynamically change in the markets (i.e., increase tracking error). A third challenge results from assuming the underlying asset distribution is stationarity over time. For example, what if the necessary model assumptions do not hold during periods of market distress (e.g., the financial crisis of 2007–2009)?

The Fama-French Three-Factor Model

LO 6.e: Describe and apply the Fama-French three-factor model in estimating asset returns.

Recall that CAPM is a single-factor model to calculate the expected return of a portfolio. The formula for CAPM is as follows:

$$E(R_i) = R_F + \beta_{i,M}RP_M + e_i$$

where:

$E(R_i)$ = the expected return on stock *i*
R_F = the risk-free rate
$\beta_{i,M}$ = the beta (factor sensitivity) between stock *i* and the market
RP_M = the risk premium for the market
e_i = a random error term which accounts for company-specific (idiosyncratic) risk

As mentioned, because well-diversified portfolios include assets from multiple asset classes, multiple risk factors will influence the systematic risk exposure of the portfolio. Therefore, multifactor APT can be rewritten as follows:

$$E(R_i) = R_F + \beta_1 RP_1 + \beta_2 RP_2 + \beta_3 RP_3 + e_i$$

where:

β_i = the beta (factor sensitivity) between stock *i* and factor exposure *i*
RP_i = risk premium associated with risk factor *i*

As mentioned previously, a major weakness of APT is that it provides no guidance on which other factors to include in a multifactor model. In 1996, economists Eugene Fama and Kenneth French famously specified a multifactor model with three factors: (1) a risk premium for the market, (2) a factor exposure for "small minus big," and (3) a factor exposure for "high minus low".[3] *Small minus big (SMB)* is the difference in returns between small firms and large firms. This factor adjusts for the size of the firm because smaller firms often have higher returns than larger firms. *High minus low (HML)* is the difference between the return on stocks with high book-to-market metrics and ones with low book-to-market values. A high book-to-market value means that the firm has a low price-to-book metric (book-to-market and price-to-book are inverses). This last factor basically means that firms with lower starting valuations are expected to potentially outperform those with higher starting valuations.

PROFESSOR'S NOTE

Notice that SMB is a hedge strategy, which is long small firms and short big firms. Likewise, HML is also a hedge strategy that is long high book-to-market firms and short low book-to-market firms.

The Fama-French three-factor model is as follows:

$$E(R_i) = R_F + \beta_{i,M}RP_M + \beta_{i,SMB}F_{SMB} + \beta_{i,HML}F_{HML} + e_i$$

The SMB and HML factors are chosen because history shows that returns are higher on smaller firms and those with high book-to-market values. Fama and French argue that these differences exist because small firms are inherently riskier than big firms. It is common knowledge that valuation levels when a trade is initiated have an impact on the ultimate outcome.

In 1997, Mark Carhart added a momentum factor to the Fama and French model to yield a four-factor model.[4] In 2015, Fama and French themselves proposed adding factors for “robust minus weak” (RMW) that accounts for the strength of operating profitability and “conservative minus aggressive” (CMA) to adjust for the degree of conservatism in the way a firm invests.[5] The point is that the Fama-French three-factor model is not the only option, but it is a widely known version of a multifactor model.

Consider an example applying the Fama-French three-factor model. A company has a beta relative to the market (β_M) of 0.85, an SMB factor sensitivity (β_{SMB}) of 1.65, and an HML factor sensitivity (β_{HML}) of −0.25. The equity risk premium is 8.5%, the SMB factor is 2.5%, the HML factor is 1.75%, and the risk-free rate is 2.75%. Given this series of inputs, the expected return for this stock is computed as:

$$E(R_i) = R_F + \beta_{i,M}RP_M + \beta_{i,SMB}F_{SMB} + \beta_{i,HML}F_{HML} + e_i$$

$$E(R_i) = 0.0275 + 0.85(0.085) + 1.65(0.025) + -0.25(0.0175) + e_i = 0.1366 = 13.66\%$$

Any return that is different from this calculated 13.66% is considered to be **alpha (α)**. The source of this alpha could be company-specific risk (e_i), or it could be that other factors need to be added to this multifactor model to better predict this stock’s future returns.

MODULE QUIZ 6.2

1. What value is derived from adding more factors through a multifactor approach?
   A. All company-specific risk can be mitigated.
   B. The same variables can be added for every stock, which makes the process easy to implement.
   C. Calculations can be derived over multiple time periods because the factor betas remain static.
   D. A richer systematic relationship can be captured.
2. Which of the following statements about correlation and diversification is correct with respect to multifactor models?
   A. Well-diversified portfolios hold constituent assets with high correlations.
   B. The use of well-diversified portfolios removes the need for multifactor models.
   C. The use of multiple assets with lower correlations makes the use of multifactor models more beneficial for analysts to consider.
   D. Well-diversified portfolios typically include assets from the same asset class.
3. Which of the following statements relative to the use of multifactor models and hedging is incorrect?
   A. Multifactor models enable investors to hedge specific factor exposures.
   B. There are still no arbitrage opportunities, even when factoring in the granular exposures captured by multifactor models.
   C. Multifactor models potentially enable investors to eliminate all calculated factor exposures.

D. The hedging process will most likely contain an element of model risk.

4. Which factors are explicitly considered in the Fama-French three-factor model?
   A. A size factor.
   B. A momentum factor.
   C. A currency exposure factor.
   D. An operational robustness factor.

KEY CONCEPTS

LO 6.a

The capital asset pricing model (CAPM) measures the expected return of a financial asset with respect to the broad market only. Arbitrage pricing theory (APT) is a type of multifactor model that expands upon the CAPM to consider any number of macroeconomic factors that may add additional explanatory power to the expected returns of a financial asset. There is not a set series of macroeconomic factors to consider, which presents analysts with a great deal of flexibility. APT also has simplified assumptions relative to the CAPM.

LO 6.b

The inputs in a multifactor model are a series of factors that influence the return on a stock. They include the expected return for the stock, a series of desired factors, and a beta for each factor. The factors are completely customizable by an analyst.

LO 6.c

A single-factor model will only consider the impact of one factor on a dependent variable (a stock's return). This leaves the potential for either company-specific risk or uncaptured systematic risk to influence asset returns. A multifactor model enables analysts to better model the impact of all systematic risk exposures to improve forecasting ability.

APT relies on well-diversified portfolios. Diversification is based on correlation between constituent assets held in a portfolio. When the assets are all sourced from the same asset class, correlations will be higher than if they are sourced from different asset classes. Therefore, a well-diversified portfolio will hold assets from different categories. This will result in a much broader pool of factors that could influence the systematic risk exposure of a given stock. Multifactor models are ideal for the need to monitor a diverse list of factors.

LO 6.d

Because multifactor models consider factor exposures on a very granular level, investors can use this approach for hedging. A specific factor exposure can be targeted for elimination, or all factor exposures can be targeted. Through the creation of a customized hedged portfolio that is scaled to the factor sensitivities of a specific portfolio, investors can potentially isolate arbitrage opportunities.

LO 6.e

Fama and French specified a three-factor model that includes the equity risk premium plus an adjustment for the size of the firm (SMB) and the firm's valuation (HML). There have been other extensions of both the CAPM and the Fama-French three-factor model (e.g., a momentum factor).

ANSWER KEY FOR MODULE QUIZZES

Module Quiz 6.1

1. **B** Arbitrage pricing theory uses a completely customizable group of variables. It explicitly mixes the return of the market with a collection of macroeconomic variables. As such, it offers more granular flexibility than CAPM. It also uses much fewer restrictive assumptions than CAPM. (LO 6.a)
2. **B** Multifactor models include a series of factors and associated betas for each factor. The selection of factors is completely customizable with no constraints, and a beta factor can be positive or negative. In either instance, the beta factor will measure the relationship between the stock and the factor in question. (LO 6.b)

Module Quiz 6.2

1. **D** Adding multiple risk factors does not eliminate company-specific risk, which is also known as nondiversifiable risk. Each stock will use its own variables, so an analyst will need to source variables for each stock under review and periodically check (and maybe change) the factors deployed because the factors and the factor betas are dynamic over time. Adding multiple risk factors does enhance the discovery of systematic risk influence. (LO 6.c)
2. **C** APT requires a well-diversified portfolio, which means that assets with lower correlations coming from different asset categories need to be included. This requirement will broaden the pool of influential factors and make a multifactor model a more attractive option. Using uncorrelated assets can lessen but not eliminate company-specific risk. (LO 6.c)
3. **B** The use of multifactor models enables investors to focus on granular risk exposures. Investors can hedge a single exposure and retain the others. They can also potentially hedge all calculated risk exposures. This process could produce arbitrage opportunities given the right circumstances. Because this hedging process is based on the calculated model, there will always be an element of model risk. (LO 6.d)
4. **A** The Fama-French three-factor model explicitly adjusts for size (SMB) and valuation (HML). Carhart added a momentum factor one year after Fama and French's original work. Fama and French also added an operating profit measure and an investment conservatism factor in a very recent extension of their own work. (LO 6.e)

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[1] Steven Ross, "The Arbitrage Theory of Capital Asset Pricing," *Journal of Economic Theory* 13, no. 3 (1976): 341–360.

[2] N. Chen, R. Roll, and S. Ross, "Economic Forces and the Stock Market," *The Journal of Business* 59, no. 3 (1986): 383–403, http://www.jstor.org/stable/2352710.

[3] E. F. Fama and K. R. French, "Multifactor Explanations of Asset Pricing Anomalies," *The Journal of Finance* 51, no. 1 (1996): 55–84.

[4] M. M. Carhart, "On Persistence in Mutual Fund Performance," *The Journal of Finance* 52, no. 1 (1997): 57–82.

[5] E. F. Fama and K. R. French, "A Five-Factor Asset Pricing Model." *Journal of Financial Economics* 116, no. 1 (2015): 1–22.

The following is a review of the Foundations of Risk Management principles designed to address the learning objectives set forth by GARP®. Cross-reference to GARP FRM Part I Foundations of Risk Management, Chapter 7.

Reading 7

PRINCIPLES FOR EFFECTIVE DATA AGGREGATION AND RISK REPORTING

Study Session 2

EXAM FOCUS

This is a highly qualitative reading that explores the Basel Committee's principles for effective risk data aggregation and risk reporting. Much of this reading is practical, in terms of the need for the data to be accurate, complete, timely, comprehensive, and adaptable. Governance principles are important, and the committee notes that risk data aggregation and reporting are expensive, and as a result, senior management and the board of directors should be fully invested in the process so that adequate resources are devoted to the effort. Risk reporting should also be accurate, comprehensive, clear, and useful. For the exam, understand how data aggregation principles interact and know that the committee implores banks to meet the requirements of each principle while still meeting the other principles. In other words, the bank should not put one principle ahead of another.

MODULE 7.1: DATA QUALITY, GOVERNANCE, AND INFRASTRUCTURE

LO 7.a: Explain the potential benefits of having effective risk data aggregation and reporting.

According to the Basel Committee on Banking Supervision, **risk data aggregation** means "defining, gathering and processing risk data according to the bank's risk reporting requirements to enable the bank to measure its performance against its risk tolerance/appetite." The aggregation process includes breaking down, sorting, and merging data and datasets. Risk management reports should reflect risks in a reliable way.

Several benefits accrue to banks that have effective risk data aggregation and reporting systems in place. These benefits include the following:

- An increased ability to *anticipate problems*. Aggregated data allows risk managers to understand risks holistically. It is easier to see problems on the horizon when risks are viewed as a whole rather than in isolation.
- In times of financial stress, effective risk data aggregation enhances a bank's ability to *identify routes to return to financial health*. For example, a bank may be better able to

identify a suitable merger partner in order to restore the bank's financial viability.

- *Improved resolvability* in the event of bank stress or failure. Regulatory authorities should have access to aggregated risk data to resolve issues related to the health and viability of banks. This is especially important for global systemically important banks (G-SIBs).
- By strengthening a bank's risk function, the bank is better able to make strategic decisions, *increase efficiency, reduce the chance of loss, and ultimately increase profitability*.

PROFESSOR'S NOTE

Banks and other organizations are increasingly dealing with "big data." Big data is data that is so large and complex that traditional data processing and analysis tools are inadequate. Data is also costly, and institutions must decide which data is worth the price. All data, big or small, must be processed and refined into usable information for risk assessment. Data analytics (e.g., artificial intelligence and machine learning) are improving and are being increasingly used for data collection and analysis. Banks that are able to capitalize on data analytics and use big data in decision-making may create a competitive advantage.

LO 7.b: Explain challenges to the implementation of a strong risk data aggregation and reporting process and the potential impacts of using poor-quality data.

Financial institutions use models for everything from analyzing risk exposures to guiding daily operations. Even small errors that occur in the model development process may result in serious consequences for a bank. Models rely on data, so data acquisition is an important component of **model risk**, specifically **input risk**.

Model risks include

- input risk,
- estimation risk,
- valuation risk, and
- hedging risk.

Historically, bank data collection efforts were disjointed, with collections occurring at the department or business function level. Data was duplicated from different sources, neglected and destroyed (e.g., changing computer systems). Computer cards and tapes, then floppy disks and drives—with all being used, and one generation of storage device was not compatible with the next.

In response to these perceived weaknesses, a special subcommittee of the Basel Committee on Banking Supervision (BCBS) was formed to examine the way banks collect, store, and analyze data. The committee concluded—and reported in a special report on risk management—that data quality was inadequate to aggregate and report risk exposures across bank lines of business. As a result, the committee published a set of 14 principles to assist banks in overhauling their data aggregation and reporting processes (BCBS 239). The goal of BCBS 239 is to enable banks to better measure performance against risk tolerances. The expectations put forth in BCBS 239 applies to data used in model development and is relevant to managing model risks. As a result of BCBS 239, there are more chief data officers in banks responsible for managing these risks.

Model developers must demonstrate that the data used in model development is consistent with the theory and methodologies behind the model. Models must be vetted and validated. There is regulatory guidance for model developers. The Federal Reserve provides guidance to banks on effective model risk management.

Standards must be consistent across departments. A bank may not understand its true risks if data is not standardized. For example, if there are different identification codes for customers across departments, the bank may not recognize its true exposure to a customer who has an auto loan, a mortgage loan, and a credit card.

LO 7.c: Describe key governance principles related to risk data aggregation and risk reporting.

LO 7.d: Describe characteristics of effective data architecture, IT infrastructure, and risk-reporting practices.

During the global financial crisis that began in 2007, many banks were unable to quickly and accurately identify concentrations of risk across business lines and at the bank group level due, in part, to an inability to aggregate risk exposures and report bank-wide risks effectively. As part of the Basel Committee's push for greater corporate governance, the committee issued supplemental Pillar 2 guidance regarding capital models and other key risk management models (e.g., value at risk) to improve banks' capabilities regarding the recognition and management of bank-wide risks.

Banks are finding it difficult to comply with BCBS 239. Senior management and the board of directors must identify issues that are preventing effective risk data aggregation and risk reporting (RDARR) and remedy deficiencies. For example, before the financial crisis of 2007–2009, erroneous or fraudulent mortgage applications came in one at a time, introducing flawed data to the system. While the loan applications came in one at a time, the ultimate failure was global, based on all the fraudulent applications. Banks that have difficulty integrating data will also have difficulty meeting the Basel principles and requirements.

Principle 1—Governance

According to the committee, "a bank's risk data aggregation capabilities and risk reporting practices should be subject to strong governance arrangements consistent with the other principles and guidance established by the Basel Committee."

The governance principle suggests that risk data aggregation should be part of the bank's overall risk management framework. To ensure that adequate resources are devoted to data aggregation and reporting, senior management should approve the framework before implementation.

Data aggregation and risk reporting practices should be as follows:

- Fully documented.
- Independently reviewed and validated by individuals with expertise in information technology (IT) and data and risk reporting functions.

- Considered when the firm undergoes new initiatives, including new product development, acquisitions, and/or divestitures. As part of an acquisition, the bank should assess the risk data aggregation and reporting capabilities of the target firm and explicitly evaluate those capabilities when deciding whether to make the acquisition. In addition, a time frame should be established to integrate the risk data aggregation and reporting processes of the two firms.
- Unaffected by the bank's structure. Specifically, decisions regarding data aggregation and reporting should be independent of the bank's physical location or geographical presence and/or legal organization.
- A priority of senior management, who should support risk data aggregation and reporting processes with financial and human resources. Senior management should include risk data aggregation and reporting in strategic IT planning and ensure that the implementation of these processes is not impeded.
- Supported by the board of directors, which should remain aware of the bank's implementation of and compliance with the key governance principles set out by the Basel Committee. RDARR should be reviewed after mergers and acquisitions.

IT systems are expensive, and risk aggregation and reporting systems require significant commitments of financial and human resources. Benefits from these investments are generally realized over the long term, not the short term. As the memories of the global financial crisis fade, banks may not give priority to the needed IT investment. The Basel Committee believes that the long-term benefits of improving risk aggregation and reporting processes will outweigh the banks' investments.

Principle 2—Data Architecture and Infrastructure

According to the committee, "a bank should design, build and maintain data architecture and IT infrastructure which fully supports its risk data aggregation capabilities and risk reporting practices not only in normal times but also during times of stress or crisis, while still meeting the other Principles."

Principle 2, as referenced in Principle 1, implores the bank to devote financial and human resources to RDARR, both when the bank is financially sound and when the bank is struggling due to financial stresses. Principle 2 requires the following:

- Risk data aggregation and reporting practices should be a part of the bank's planning processes and subject to business impact analysis.
- Banks establish integrated data classifications and architecture across the banking group. Multiple data models may be used as long as there are robust automated reconciliation measures in place. Data architecture should include information on data characteristics (metadata) and naming conventions for legal entities, counterparties, customers, and account data.
- Accountability, roles, responsibilities, and ownership should be defined relative to the data. Adequate controls should be in place throughout the life cycle of the data for all aspects of the technology infrastructure. Risk managers, business managers, and/or IT functions are responsible for data, ensuring that it is entered correctly, is relevant and current, is aligned with data taxonomies, and is consistent with bank policies.

Data models may be used to create information on data characteristics. The main data models (also called schemas) are as follows:

- **Semantic data models**. These models structure data in a logical order and include semantic information such as the basic meaning of data and the relationships between data.
- **Conceptual data models**. Conceptual models are the most abstract. These models map the concepts and relationships used in databases and confirm the way humans understand systems and system objectives.
- **Logical data models**. Logical data models describe data in as much detail as possible. These models are not concerned with implementation.
- **Physical data models**. The components required to build a database, such as the logical database components, are defined in a physical data model. The structure of a database table, including column names and values, primary and foreign keys, and relationships among tables, are included. Physical data models translate concepts and logical data into implementable data to be used in hardware/software system platforms.

Banks that have an effective and compliant data architecture and IT infrastructure are better able to understand risks and make adjustments around changes in business activities.

MODULE QUIZ 7.1

1. Jeffrey Gibson, a bank supervisor with a national regulatory agency, has requested as part of a bank examination that Star Bank, a global systemically important bank (G-SIB), improve its aggregation and reporting of risk data. Star Bank has experienced significant losses resulting from multiple causes, ranging from poor lending decisions to bad decisions regarding the use of derivatives. The bank is now undercapitalized because of losses. Gibson refers Star Bank's risk managers to the Basel Committee's recommendations for effective risk data aggregation. He informs risk committee members and senior management that one of the potential direct benefits of effective risk data aggregation, particularly in light of Star Bank's current troubles, is:
   A. increased bank efficiency.
   B. more effective IT infrastructure.
   C. improved resolvability of bank problems.
   D. a clearer definition of the bank's risk appetite.
2. Donna Grinstead is the risk management officer at Republic Bank. She is establishing governance principles for effective risk data aggregation. The bank has historically been lenient with respect to risk management processes, and Grinstead has been hired to remedy the situation. Which of the following statements regarding governance principles is false?
   A. The overall risk management framework of the bank should include risk data aggregation.
   B. Human and financial resources should be devoted to risk data aggregation, and thus senior management should approve the framework.
   C. A bank should have multiple sources for risk data for each type of risk to improve reliability.
   D. Risk data aggregation should be considered when the firm undergoes new initiatives, including acquisitions and divestitures.
3. A bank should include information on data characteristics (metadata) and naming conventions for legal entities, counterparties, customers, and account data in aggregated risk data. This is suggested by the Basel Committee on Banking Supervision in the

principle related to:

A. accuracy.
B. completeness.
C. clarity and usefulness.
D. data architecture and infrastructure.

MODULE 7.2: RISK DATA AGGREGATION AND REPORTING CAPABILITIES

Principle 3—Accuracy and Integrity

According to the committee, "a bank should be able to generate accurate and reliable risk data to meet normal and stress/crisis reporting accuracy requirements. Data should be aggregated on a largely automated basis so as to minimize the probability of errors."

Principle 3 requires the following:

- Data aggregation and reporting should be accurate and reliable.
- Controls applied to risk data should be as robust as those surrounding accounting data.
- To ensure the quality of the data, effective controls should be in place when the bank relies on manual processes and desktop applications such as spreadsheets and databases.
- Data should be reconciled with other bank data, including accounting data, to ensure its accuracy.
- A bank should endeavor to have a single authoritative source for risk data for each specific type of risk.
- Risk personnel should have access to risk data to effectively aggregate, validate, reconcile, and report the data in risk reports.
- The production of aggregate risk information should be timely.
- Data should be defined consistently across the bank. The bank may maintain a dictionary of risk data concepts and terms.
- While data should be aggregated on a largely automated basis to reduce the risk of errors, human intervention is appropriate when professional judgments are required. There should be balance between manual and automated risk management systems.
- Bank supervisors expect banks to document manual and automated risk data aggregation systems and explain when there are manual workarounds, why the workarounds are critical to data accuracy, and propose actions to minimize the impact of manual workarounds.
- Banks monitor the accuracy of risk data and establish plans to correct poor data quality.

Principle 4—Completeness

According to the committee, "a bank should be able to capture and aggregate all material risk data across the banking group. Data should be available by business line, legal entity,

asset type, industry, region and other groupings, as relevant for the risk in question, that permit identifying and reporting risk exposures, concentrations and emerging risks."

Principle 4 requires the following:

- Both on- and off-balance sheet risks should be aggregated.
- Risk measures and aggregation methods should be clear and specific enough that senior managers and the board of directors can properly assess risk exposures. However, not all risks need to be expressed in the same metric.
- Bank risk data should be complete. If risk data is not complete, the bank should identify and explain areas of incompleteness to bank supervisors.

Principle 5—Timeliness

According to the committee, "a bank should be able to generate aggregate and up-to-date risk data in a timely manner while also meeting the principles relating to accuracy and integrity, completeness and adaptability. The precise timing will depend upon the nature and potential volatility of the risk being measured as well as its criticality to the overall risk profile of the bank. The precise timing will also depend on the bank specific frequency requirements for risk management reporting, under both normal and stress/crisis situations, set based on the characteristics and overall risk profile of the bank."

Principle 5 requires the following:

- Risk data aggregation should be timely and should meet all requirements for risk management reporting. Bank supervisors will review the timeliness and specific frequency requirements of bank risk data in normal and stress/crisis periods.
- Systems should be in place to produce aggregated risk data quickly in stress/crisis situations for all critical risks. Critical risks include but are not limited to
  - aggregated credit exposures to large corporate borrowers;
  - counterparty credit risk exposures, including derivatives;
  - trading exposures, positions, and operating limits;
  - market concentrations by region and sector;
  - liquidity risk indicators; and
  - time-critical operational risk indicators.

The degree of timeliness varies depending on the business line. For example, portfolio managers must evaluate risk data quickly and often, faster and more frequently than, for example, corporate lending. Trading positions are established using sophisticated valuation algorithms. Details of financial instrument contracts are recorded in customized vendor or in-house designed data structures.

Principle 6—Adaptability

According to the committee, "a bank should be able to generate aggregate risk data to meet a broad range of on-demand, ad hoc risk management reporting requests, including requests during stress/crisis situations, requests due to changing internal needs and requests to meet supervisory queries."

Principle 6 requires the following:

- Data aggregation capabilities should be adaptable and flexible. Adaptable data makes it easier for managers and the board of directors to conduct stress tests and scenario analysis. Data should be available for ad hoc data requests to assess emerging risks. Adaptability includes the following:

  – Aggregation processes should be flexible and should allow bank managers to assess risks quickly for decision-making purposes.

  – Data should be customizable (e.g., anomalies, dashboards, and key takeaways) and should allow the user to investigate specific risks in greater detail.

  – It should be possible to include new aspects of the business or outside factors that influence overall bank risk in the risk data aggregation process.

  – Regulatory changes should be incorporated in risk data aggregation.
- A bank should be able to pull out specifics from aggregated risk data. For example, a bank should be able to aggregate risks of a certain country or region. Credit risk exposures (e.g., corporate, bank, sovereign, and retail exposures) for a specific country should be readily accessible. Data regarding risks across geographic areas or business lines should be available as needed.

The principles of accuracy and integrity, completeness, timeliness, and adaptability interact; a bank may choose to put one principle ahead of another, or the data is aggregated with one principle in mind while ignoring another. For example, in the interest of speed and timeliness, a bank might take shortcuts with respect to completeness. Also, the accuracy and integrity of the data may suffer if a bank is in a hurry to comply with the timeliness standard. In addition, the data could be compiled in such a way that supports accuracy and integrity but makes the data inflexible and not easily adaptable for specific needs. The bank should consider all the standards when creating and maintaining a risk data aggregation framework.

Effective risk reporting practices include

- clear, complete, timely, and accurate data; and
- reporting of risk data to the right people at the right time. In other words, the key decision-makers should have access to the data in a timely fashion to allow for good decision-making.

In recent reports, the BCBS contrasts effective and ineffective risk data aggregation and risk reporting. *Effective risk data aggregation and reporting* includes "appropriate data element certification, data quality documentation, data quality assurance mechanisms, assessment of data quality per risk type, and documented and effective controls for manual processes."

In contrast, *ineffective risk data aggregation and reporting* may include

- efficiencies in data quality control;
- improperly established data quality rules (e.g., lacking minimum standards for reporting);
- lack of oversight;
- lack of an effective escalation model;

- weaknesses in quality control;
- overuse of improperly documented manual processes;
- lack of reconciliation between key risk reports;
- lack of variance analysis;
- inability to get risk data from foreign subsidiaries in a timely fashion; and
- lack of standardization of reference data.

Principle 7—Accuracy

According to the committee, "risk management reports should accurately and precisely convey aggregated risk data and reflect risk in an exact manner. Reports should be reconciled and validated."

Principle 7 requires the following:

- Risk reports should be accurate and precise. Senior managers and board members should be able to use the reports to make critical decisions about bank risks.
- To ensure the accuracy of risk reports, the bank should
  – define the processes used to create risk reports;

  – create reasonableness checks of the data;

  – include descriptions of mathematical and logical relationships in the data that should be verified; and

  – create error reports that identify, report, and explain weaknesses or errors in the data.
- The bank should ensure the reliability, accuracy, and timeliness of risk approximations (e.g., scenario analysis, sensitivity analysis, stress testing, and other risk modeling approaches).
- The board of directors and senior managers should establish precision and accuracy requirements for regular and stress/crisis risk reports.
- Bank supervisors expect banks to impose accuracy requirements on risk data (both regular and stress/crisis) commensurate with and analogous to accounting materiality. For example, if an omission influences risk decision-making, then it is deemed material.

Principle 8—Comprehensiveness

According to the committee "risk management reports should cover all material risk areas within the organization. The depth and scope of these reports should be consistent with the size and complexity of the bank's operations and risk profile, as well as the requirements of the recipients."

Principle 8 requires the following:

- Reports should contain position and risk exposure information for all relevant risks, such as credit risk, liquidity risk, market risk, and operational risk. The report should

also include detailed information for specific risks such as country, region, or sector exposures.

- Risk reports should be forward-looking and should include forecasts and stress tests. The bank's risk appetite/tolerance should be discussed in the context of emerging risks.
- Bank supervisors should be satisfied that the bank's risk reporting is sufficient in terms of coverage, analysis, and comparability across institutions. A risk report should include, but not be limited to, information regarding
  - credit risk,
  - market risk,
  - liquidity risk,
  - operational risk,
  - results of stress tests,
  - capital adequacy,
  - regulatory capital,
  - liquidity projections,
  - capital projections,
  - risk concentrations, and
  - funding plans.

PROFESSOR'S NOTE

These comprehensive risks are called Pillar 1 and Pillar 2 risks. Pillar 1 risks include market risk, credit risk, and operational risk—in other words, risks at the heart of bank operations and identified in the Basel I Accord. Minimum capital requirements were tied to these Pillar 1 risks. Pillar 2 risks expand upon Basel I to include business risk, reputation risk, concentration risk, strategic risk, and others.

Principle 9—Clarity and Usefulness

According to the committee "risk management reports should communicate information in a clear and concise manner. Reports should be easy to understand yet comprehensive enough to facilitate informed decision-making. Reports should include meaningful information tailored to the needs of the recipients."

Principle 9 requires the following:

- Reports should be tailored to the end user (e.g., the board, senior managers, and risk committee members) and should assist them with sound risk management and decision-making.
- Reports will include
  - risk data,
  - risk analysis,
  - interpretation of risks, and
  - qualitative explanations of risks.

Different members of the organization have different needs in terms of reporting. For example, information relevant to the risk committee may not be specifically relevant to the board of directors. Information may be relevant to traders but not to lenders and vice versa. There is a greater need for qualitative interpretation and explanation as aggregation increases.

- The board of directors should ensure that the bank is operating within its risk tolerance/appetite and should therefore make sure that it is asking for and receiving relevant risk information to make the determination. The mix of quantitative data versus qualitative data is important.
- Risk data should be classified, and the bank should develop an inventory of terms used in risk reports.
- Bank supervisors will confirm periodically that the risk data is clear, relevant, and useful for decision-making.

Principle 10—Frequency

According to the committee, "the board and senior management (or other recipients as appropriate) should set the frequency of risk management report production and distribution. Frequency requirements should reflect the needs of the recipients, the nature of the risks reported, and the speed at which the risks can change, as well as the importance of reports in contributing to sound risk management and effective and efficient decision making across the bank. The frequency of reports should be increased during times of stress/crisis."

Principle 10 requires the following:

- The frequency of reports will vary depending on the recipient (e.g., the board, senior managers, and risk committee members), the type of risk, and the purpose of the report. The bank should periodically test whether reports can be accurately produced in the established time frame both in normal and stress/crisis periods.
- In stress/crisis periods, liquidity, credit, and market risk reports may be required immediately in order to react to the mounting risks.

The frequency of reporting may increase during stress periods in order to facilitate decision-making during rapidly changing financial markets. However, in some cases, reporting frequency must slow because the volume of data is so large (e.g., stochastic cash flow simulations). It becomes difficult to maintain data quality checks if there is too much output data. Additionally, there must be consistency across scenario iterations.

Principle 11—Distribution

According to the committee, "risk management reports should be distributed to the relevant parties while ensuring confidentiality is maintained."

Principle 11 requires the following:

- Reports should be disseminated in a timely fashion while maintaining confidentiality where required. Supervisors expect banks to confirm that recipients receive reports in a timely manner.

In sum, effective data reporting will provide useful information that allows managers to act preemptively. Reporting will be dynamic. The interface should be easy to use and allow managers to perform rigorous analyses using risk data. Ineffective risk reporting is often inflexible, difficult to understand, and/or apply and does not allow managers to answer drill down questions.

In general, studies indicate that banks are having difficulty complying with the Principles. One PricewaterhouseCoopers (PwC) study indicated higher performance with risk reporting Principles 7–11 but poorer performance with respect to data aggregation Principles 3–6. Additionally, Principles 1 and 2, governance and data architecture and infrastructure, respectively, also have poor compliance rates.

MODULE QUIZ 7.2

1. Emily Lister, a risk management specialist at American Bank and Trust, has been asked, as part of Principle 3 on the accuracy and integrity of aggregated risk data, to provide a report to bank supervisors on why a bank employee decided to forgo the automated processes put in place by the risk management team and write data entries by hand. Lister believes it was necessary after discussing the action with the employee. In her report, she details why it was necessary for the employee to forgo automated processes and why she believes the integrity of the data is still intact. In the report, she is describing:
   A. a breach of protocol.
   B. a manual workaround.
   C. a reliability exception to Principle 3.
   D. an unexcused exception to risk data aggregation principles.
2. Senior management and the board of directors should receive accurate and timely aggregated risk data reports for all of the following reasons except:
   A. bank supervisors request risk reports from board members, who should be prepared to provide this information during bank examinations.
   B. senior management and board members use risk reports to make decisions regarding bank risks.
   C. senior management and board members should react in times of financial stress and/or crisis and need reliable risk reports to make good decisions.
   D. the board should ensure that the bank is operating within its risk tolerance/appetite and should therefore make sure that it receives relevant risk information.

KEY CONCEPTS

LO 7.a

Benefits that accrue from effective risk data aggregation and reporting include (1) an increased ability of managers and the board to anticipate problems, (2) enhanced ability to identify alternative routes to restore financial health in times of financial stress, (3) improved resolvability in the event of bank stress or failure, and (4) an enhanced ability to make strategic decisions, increasing the bank's efficiency, reducing the chance of loss, and ultimately increasing bank profitability.

LO 7.b

Financial models are used by banks for everything from analyzing risk exposures to guiding daily operations. Even small errors that occur in the model development process may result

in serious consequences for a bank. Models rely on data, so data acquisition is an important component of model risk, specifically input risk. Model developers must demonstrate that the data used in model development is consistent with the theory and methodologies behind the model. Models must be vetted and validated.

LO 7.c

The governance principle (Principle 1) suggests that risk data aggregation should be part of the bank's overall risk management framework. The board and senior management should assure that adequate resources are devoted to risk data aggregation and reporting.

LO 7.d

The data architecture and IT infrastructure principle (Principle 2) states that a bank should design, build, and maintain data architecture and IT infrastructure that fully supports its risk data aggregation capabilities and risk reporting practices not only in normal times but also during times of stress or crisis, while still meeting the other principles. It stresses that banks should devote considerable financial and human resources to risk data aggregation and reporting.

Principles 3–6 specify standards and requirements for effective risk data aggregation. Banks should ensure that the data is accurate and has integrity (Principle 3), is complete (Principle 4), is timely (Principle 5), and is adaptable to the end user (Principle 6). In addition, the bank should not have high standards for one principle at the expense of another. Aggregated risk data should exhibit all of the features together, not in isolation.

Principles 7–11 specify standards and requirements for effective risk reporting practices. Risk reports should be accurate (Principle 7), comprehensive (Principle 8), and clear and useful (Principle 9). Principle 10 states that reports should be "appropriately frequent" (i.e., frequency depends on the role of the recipient and the line of business—board members need reports less frequently than risk committee members and those in the trading unit need reports more frequently than those in the lending unit). Reports should be distributed to relevant parties in a timely fashion while maintaining confidentially (Principle 11).

ANSWER KEY FOR MODULE QUIZZES

Module Quiz 7.1

1. **C** There are several benefits that accrue to banks that have effective risk data aggregation and reporting systems in place. These benefits include an increased ability to anticipate problems. Also, in times of severe financial stress, effective risk data aggregation enhances a bank's ability to identify alternative routes to restore financial health. Regulatory authorities should have access to aggregated risk data to resolve issues related to bank health and viability. This aids regulators in resolving problems in the event of financial stress. By strengthening a bank's risk function, the bank is better able to make strategic decisions, increase efficiency, reduce the probability of loss and ultimately increase profitability. In this case, the bank appears to be in financial stress, so the most relevant benefit is improved resolvability. (LO 7.a)

2. **C** Governance principles for risk data aggregation relate to overall bank processes and the roles of senior management and the board in supporting risk data aggregation and reporting. Data sources relate to the accuracy and integrity of the data, not governance. In addition, the bank should strive to have a single source for risk data, not multiple sources. (LO 7.c)

3. **D** Principle 2, data architecture and infrastructure, requires that risk data aggregation and reporting practices should be a part of the bank's planning processes and subject to business impact analysis. Banks should establish integrated data classifications and architecture across the banking group. Multiple data models may be used as long as there are robust automated reconciliation measures in place. In addition, data architecture should include information on data characteristics (metadata) and naming conventions for legal entities, counterparties, customers, and account data. (LO 7.d)

Module Quiz 7.2

1. **B** As part of Principle 3 on the accuracy and integrity of aggregated risk data, bank supervisors expect banks to document manual and automated risk data aggregation systems and explain when there are manual workarounds, explain why the workarounds are critical to data accuracy, and propose actions to minimize the impact of a manual workaround. (LO 7.d)

2. **A** It is important for the board and senior management to have accurate and timely risk reports to oversee the bank's risk-taking activities. The bank's risk tolerance/appetite is monitored by the board. The board and senior managers should be prepared to make decisions in times of financial stress and crisis. The board does not provide reports to regulators. Information requests from supervisors would be made at the bank level, not the board level. (LO 7.d)

The following is a review of the Foundations of Risk Management principles designed to address the learning objectives set forth by GARP®. Cross-reference to GARP FRM Part I Foundations of Risk Management, Chapter 8.

Reading 8

ENTERPRISE RISK MANAGEMENT (ERM) AND FUTURE TRENDS

Study Session 2

EXAM FOCUS

Enterprise risk management (ERM) is a relatively recent concept that emerged in response to moving away from the traditional approach to risk management under which each risk was assessed, managed, and mitigated separately by a specific unit within the firm. In this reading, you will gain familiarity with the concept and definitions of ERM, its advantages and disadvantages, and the five important dimensions of an ERM program. The importance of a strong risk culture, as well as the factors that impede a strong risk culture, are discussed at length. The importance of scenario analysis as a primary risk identification/management tool is discussed. Also, the role that scenario analysis and stress testing plays in capital planning is explored. For the exam, be able to discuss the movement from a silo-based approach to risk management toward an enterprise-wide approach, and the advantages of a holistic, firmwide approach. Also, be able to link ERM to scenario analysis/stress testing and ultimately to bank capital planning.

MODULE 8.1: ENTERPRISE RISK MANAGEMENT

LO 8.a: Describe ERM and compare an ERM program with a traditional silo-based risk management program.

Companies face various risks that arise from company operations, including but not limited to credit, market, liquidity, operational, business, and information technology (IT) risks. Within the traditional approach to risk management, each of these primary risk types was evaluated by a specific unit within the organization in isolation (i.e., a **silo-based risk management system**), independent of the other risk types. For example, a company's traders were responsible for managing market risk, actuaries managed insurance risk, and management analyzed business risk.

While the traditional, silo-based approach may have been adequate in a less volatile market environment, it suffers from the shortcoming of ignoring the dynamic nature of risks and their interdependencies. One risk type can affect another, and risks (or their hedges) can be offsetting if viewed from the perspective of the entire company. Treating each primary risk type in isolation ignores these interdependencies and can result in inefficient and costly

overhedging of risks at the firm level. In addition, the various functional units responsible for evaluating and measuring risks may all use different methodologies and formats in their risk measurements. Without a centralized risk management system, a company's senior management and its board of directors will receive fragmented information from the various units, each potentially utilizing different measurement methods.

Given the noted shortcomings of the traditional approach, an integrated and centralized framework would significantly increase the efficiency of managing company risks. Such a centralized approach is called **enterprise risk management (ERM)**.

Risk management tools include avoiding, retaining, mitigating, and transferring risks. In a siloed approach, these are typically treated as separate decisions, without a strategic approach to the overall enterprise risk. Under an ERM view, risks are viewed as a component of the whole.

Figure 8.1: Comparing Silo-Based Risk Management and ERM

Silo-Based Risk Management	ERM
Managing risks within the lines of business	Reviewing risks across all business lines, functional areas, and risk types. Risk managers look for areas of diversification, as well as concentration to avoid the costs of overhedging.
Isolated risk managers	Integrated risk managers and a chief risk officer
Multiple risk metrics that cannot be compared	Integrated risk metrics that can be compared (apples to apples). For example, scenario analysis and value at risk (VaR).
Difficult to see enterprise/ aggregate risks	Aggregate risks across business lines and potentially across types of risk.
Hedging risks with specific risk transfer tools	Potential cost savings from integrated, multitrigger hedging instruments
Risk management and risk transfer are not integrated with balance sheet management and financing strategies.	Risk management is integrated with the bank's capital management strategy, balance sheet management strategy, and financing strategies.

ERM Motivations

LO 8.b: Describe the motivations for a firm to adopt an ERM initiative.

There are many benefits of an ERM approach to managing risks. They are as follows:

- ERM helps managers define the risk appetite of the entire enterprise and helps firms adhere to the constraints put on risk.
- It allows managers to focus on the largest threats to the firm, threats to the firm's survival, rather than day-to-day threats to specific units and business lines.
- ERM identifies threats to the entire operation that arise from individual business lines.
- Emerging risks, such as cyber threats, reputation risks, and anti-money laundering (AML) risks, are better managed at the enterprise level.
- ERM supports regulatory compliance.

- ERM is reassuring to stockholders and other stakeholders of the financial institution.
- ERM helps managers understand crossover risks (i.e., when risks create additional risks) and as well as correlations between specific risk types.
- Total costs of transferring risks (i.e., an optimization of risk transfer expenses) in line with the scale of various risks are better managed through ERM.
- Capital costs associated with stress testing are incorporated into pricing and decision-making.
- Risk is incorporated into business model selection and the strategic decisions of the bank.

ERM Best Practices

LO 8.c: Explain best practices for the governance and implementation of an ERM program.

Corporate governance is critical in the implementation of a successful ERM program and ensures that senior management and the board have the requisite organizational practices and processes to adequately control risks. Corporate governance practices have evolved considerably through recent regulatory initiatives including the Turnbull Report and the Sarbanes-Oxley Act.

A successful corporate governance framework requires that senior management and the board adequately define the firm's risk appetite and risk and loss tolerance levels. In addition, management should remain committed to risk initiatives and ensure that the firm has the required risk management skills and organizational structure to successfully implement the ERM program. An effective framework also requires that all key risks are successfully integrated into the ERM program and that those responsible for implementing the program have clearly defined risk roles and responsibilities, including the role of the chief risk officer (CRO). Oversight, audit, and monitoring targets are also crucial components of the ERM governance process.

ERM Program Dimensions

ERM is organized around the following five important dimensions:

1. *Targets.* Banks should set the correct risk targets. Risk targets should not be in conflict with the strategic goals of the institution. Targets include the following:
    a. Risk appetite. Operational mechanisms such as compensation plans and global risk limits are linked to the risk appetite of the firm.
    b. Strategic goals in light of the firm's risk appetite.
2. *Structure*. As part of the ERM structure, the roles of relevant parties are defined (i.e., chief risk officer, global risk committee, other risk committees) along with a description of the firm's governance structure. The structure should ensure that enterprise-wide risks are identified and that direct and indirect losses are considered. Reporting lines are established in the ERM structure (e.g., business-line managers, risk committees, the chief risk officer).

3. *Identification and metrics*. Enterprise risks must be measured in terms of the impact on the firm, the severity of the risks, and, ideally, the frequency of occurrence. One goal of ERM is to make sure that the firm has the right metrics in place to capture whole-firm risks. Metrics that are used include
   – scenario analysis,
   – stress testing,
   – value at risk (VaR),
   – total cost of risk approaches,
   – enterprise-wide risk mapping,
   – risk-specific metrics, and
   – risk flagging tools.

   In terms of identification, risk managers must be aware of concentrations. For example, there may be credit risk concentrations within the bank's loan portfolio. There may also be sector concentrations (i.e., too many loans to firms in a specific industry) or loan type concentrations (e.g., land development loans). Concentrations can exist at the borrower level as well. For example, a borrowing firm may have too great a reliance on a single supplier, increasing credit risk. Financial institutions may also have too great a reliance on specific data providers, risk analysis providers, and technology providers.
4. *ERM strategies*. Firms must articulate the methods and strategies that will be used to manage risks at the whole-firm and business-line levels. Decisions regarding whether risk will be avoided, mitigated, or transferred must be made at the enterprise level. Risk transfer instruments must also be identified.
5. *Culture*. The firm's risk culture is the heart and soul of ERM. A firm must instill in its employees the importance of risk management through the goals, practices, and behaviors of those in top management positions on down through the ranks of the firm.

Understanding the interactions of the key ERM dimensions is important to understanding enterprise risks. A strong corporate risk culture is important. For example, a newly appointed CRO may not necessarily positively impact the firm's risk culture if it is cynically perceived as "rebranding" the risk culture without real change. Also, it is important that the ERM program be comprehensive. For example, surveys of CROs indicate that only about half of them review compensation plans. This is insufficient in that compensation plans often lead to and even encourage risky behavior.

MODULE QUIZ 8.1

1. The basis of enterprise risk management (ERM) is that:
   A. risks are managed within each risk unit but centralized at the senior management level.
   B. the silo approach to risk management is the optimal risk management strategy.
   C. risks should be managed and centralized within each business or risk unit.
   D. it is necessary to appoint a chief risk officer to oversee most risks.
2. Jimi Chong is a risk analyst at a mid-sized financial institution. He has recently come across an article that described the enterprise risk management (ERM) process. Chong does not believe this is a well-written article, and he identified four statements that he thinks are incorrect. Which of the following statements identified by Chong is actually correct?
   A. One of the drawbacks of a fully centralized ERM process is overhedging risks and taking out excessive insurance coverage.

B. ERM benefits include better management of risks at the business level, improved business performance, and better risk reporting.
C. ERM uses sensitivity analysis instead of scenario analysis to analyze potential threats.
D. A strong ERM program allows a firm to focus on the largest risks facing the enterprise.

3. Which of the following targets should be set as part of an ERM program?
   A. The maximum value at risk (VaR) under multiple stress test scenarios.
   B. The firm's risk appetite.
   C. The firm's Tier 1 capital to asset ratio.
   D. The optimal size of the ERM Committee.

MODULE 8.2: RISK CULTURE AND SCENARIO ANALYSIS

Risk Culture Characteristics and Challenges

LO 8.d: Describe risk culture, explain the characteristics of a strong corporate risk culture, and describe challenges to the establishment of a strong risk culture at a firm.

The **risk culture** of a firm is the goals, customs, values, and beliefs (both implicit and explicit) that influence the behaviors of employees. These corporate norms guide individuals in their understanding and responses to risk. Bank supervisors identified risk culture as a primary contributor to bank failures in the aftermath of the 2007–2009 financial crisis. Examples of weak risk cultures abound, including

- the LIBOR rate manipulation scandal which came to light in 2012;
- money laundering by banks; and
- subprime lending that was a part of the lending cultures of many financial firms leading up to the financial crisis.

Establishing a strong risk culture is difficult because it is multilayered. Individuals have their own risk attitudes when they come to work for a firm. Demographics, family backgrounds and experiences, personalities, and professional codes and standards all influence an individual's risk appetite. Peers, as well as management, also influence the risk behaviors of employees. Risk culture happens at the enterprise level, the group level (e.g., group think, recruitment of individuals who think like the group), and the individual level.

Firms need methods to measure progress in terms of risk culture. One method is to identify the *key risk culture indicators* of the firm. The Financial Stability Board (FSB) has specified four risk indicators:

1. *Tone from the top of the organization*. Are the actions of management in conflict with stated risk goals/appetites? Do compensation plans support the values of the firm or encourage risk-taking? How does the board of directors communicate the fit between risk appetite and firm strategies and goals?
2. *Effective communication and challenge*. Are opposing views valued? Are there assessments of managements' "openness to dissent?" Is there stature associated with risk management (or just with performance)?

3. *Incentives*. Are compensation plans supportive of and in alignment with risk appetite/risk culture?
4. *Accountability*. Are expectations clear? Are escalation processes used?

Other factors that can be used to build a strong risk culture include the following:

- *Knowledge of the firm's risk appetite*. Do staff understand the firm's risk appetite? Is it communicated? Can they answer questions about its application in day-to-day business operations?
- *Risk literacy*. Are there training programs (that are attended) regarding risk? Do staff know the language used to describe risks and the consequences of risk-taking?
- *The flow of risk information*. Does information about risk flow across the firm? Are there clear links between the discussions of risk and the decisions made by firm managers?
- *Risk/reward decisions of managers*. Are managers consistent when it comes to risks and rewards in the context of the firm's risk appetite?
- *Risk management stature*. Does the CRO and other risk managers have stature in the firm? Who hires and fires risk managers?
- *Whistleblowing and escalation*. Do staff understand the firm's escalation process if they want to report enterprise risks? Is there a method in place for whistleblowers to "blow the whistle?"
- *Priorities of the board*. Can board members name the top 10 enterprise risks? Can members name industry disasters associated with these risks?
- *Actions against offenders*. Are employees who violate risk standards disciplined?
- *Identification of risk culture concerns/incidents*. Can the firm identify risk incidents and the actions that were taken in response to violations?

Other factors, including industry and professional norms, affect risk culture. Additionally, factors such as credit cycles (e.g., prefinancial crisis lending standards and actions) can also affect risk culture. External factors such as the economic cycle, changing industry practices, professional and regulatory standards, and country risks and corruption indices are also important.

Survey and other data can be used to develop a risk culture score. These measures help the firm understand changes in the risk culture, but they do not quantify the losses associated with failures related to the firm's risk culture.

Factors that may prevent firms from developing robust risk cultures include the following:

- *Risk indicators that become risk levers*. Firms must identify indicators of risk. However, in many cases it is easier to manage the risk indicator than to actually improve the firm's risk culture.
- *Risk education*. Risk education shouldn't only be for employees, but it is important throughout the organization, including for members of the board of directors. The board must be able to list key enterprise risks and relate key risks to the firm's risk appetite. Having common risk language that is used by all employees and the board is useful.

- *Risk across the organization and across time*. Risks are generally established in business lines, not at the enterprise level. Business lines often develop their own risk cultures (e.g., sales cultures). The enterprise should have mechanisms for identifying risks that also appear in multiple business lines.
- *Culture cycle*. Risk culture is more evident in times of crisis and the feelings, and fears that are resurrected during crisis periods fade over time (meaning that risky behavior may diminish during and after a crisis but resuscitate as the memory of the "pain" subsides).
- *Curse of data*. There is an ever-increasing amount of data available for analyzing risks. For example, the number of sick days taken (human resource data) may be a risk/risk culture indicator. As data become more plentiful, firms may need to employ machine learning to draw useful insights and conclusions from the abundance of information available.

Scenario Analysis and Stress Testing

LO 8.e: Explain the role of scenario analysis in the implementation of an ERM program and describe its advantages and disadvantages.

Sensitivity analysis involves changing one variable at a time and assessing the sensitivity of the model (e.g., assessing the impact on net income) to that one variable. **Scenario analysis**, on the other hand, looks at multiple variables at once and involves developing a narrative to explain why variables change and the effects of those changes. Sophisticated financial models are developed to assess the impact of various scenarios on the risks and performance of the enterprise.

Probabilistic risk metrics, such as VaR, were revealed to have weaknesses as the global financial markets melted down in 2007–2009. Actual risk levels (e.g., 25 standard deviation moves multiple days in a row) seemed inconceivable based on VaR models. As such, scenario analysis and stress testing have become the most important tools in ERM program risk identification. Scenario analysis helps the firm understand the effects of abnormal/tail events.

Advantages of scenario analysis include the following:

- Risk frequency is irrelevant. The risk must simply be plausible.
- Scenarios can be intuitive and transparent.
- Firms must imagine the worst thing that could happen and the consequences of that potential worst-case scenario.
- It helps firms focus on key risk types and risk exposures.
- It helps firms see potential warning signals and develop contingency plans to manage risk events.
- It may be forward looking, using hypothetical events, or may be based on historical data.
- Scenario analysis may be straightforward or highly sophisticated.

- Scenario analysis may be used to develop the firm's risk appetite, set risk limits, and be used in capital adequacy planning.

Disadvantages of scenario analysis include the following:

- Probabilities of adverse events are difficult to estimate. Also, scenario analysis does not lead to a quantification of risk because the exercise is qualitative in nature (though quantitative models are built around scenarios).
- Scenarios are complex.
- Scenarios may underestimate possible events and the effects of those events.
- Is the firm developing the "right" scenarios (only a limited number can be fully developed)?
- Is the firm focusing on the correct warnings and developing the right plans, based on the limited scenarios that are fully developed?
- Scenarios are often based on the last big crisis, rather than what might lie in the future.
- Because scenario analysis may be sophisticated or straightforward, credibility may be difficult to assess.
- The usefulness of scenario analysis depends on accuracy, comprehensiveness, and whether the analysis captures future risks, not just past risks.

PROFESSOR'S NOTE

Notice that what is an advantage through one lens is a disadvantage through another. For example, scenarios may be intuitive and transparent narratives (an advantage) but are necessarily complex (a disadvantage). When studying the advantages and disadvantages of scenario analysis, keep this in mind.

LO 8.f: Explain the use of scenario analysis in stress testing programs and capital planning.

Before the 2007–2009 financial crisis, banks typically built historical scenarios based on real-life historical events. Examples of scenarios before and during the crisis include:

- 1997 Asian crisis
- 1998 Russian debt moratorium
- 2001 September 11 effects on financial markets
- 2007 subprime mortgage crisis
- 2008 failure of Lehman Brothers and the resulting counterparty crisis

However, it was not clear to banks how many historical and/or hypothetical scenarios to include. For example, following the Russian debt default, Long-Term Capital Management (LTCM) nearly collapsed. These two events were related, but banks did not necessarily include one with the other when conducting scenario analysis. It was clear following the 2007–2009 financial crisis that banks had failed to see how risks interacted and how market participant behaviors changed during periods of stress. Regulators also noted that banks tested scenarios that were milder than what eventually occurred during 2007–2009. As such, regulators demanded that banks demonstrate the ability to withstand more brutal, realistic scenarios.

U.S. **stress testing** of banks began in 2009 with the initial Supervisory Capital Assessment Program (SCAP). The Dodd-Frank Act stress tests (DFAST) are conducted mid-year for all banks with assets of $10 billion or more, and the Comprehensive Capital Analysis and Reviews (CCAR) are conducted at year-end for banks with assets of $50 billion or more. While the scenarios for DFAST and CCAR are the same (devised by supervisors), DFAST is more prescriptive, requires less reporting, and requires limited capital action assumptions.

Since 2011, the Federal Reserve has conducted annual stress tests. The Federal Reserve requires banks to consider the following three macroeconomic scenarios:

- *Baseline*. This scenario is based on the consensus economic forecasts of economists at large banks.
- *Adverse*. This scenario assumes a moderately declining economy.
- *Severely adverse*. This scenario assumes a global recession/depression with a corresponding decline in demand for fixed-income investments.

CCAR requires projections over a nine-quarter horizon and is complex, requiring banks to dynamically forecast balance sheets and income statements. This means banks must forecast

- revenues,
- loan loss provisions,
- credit losses related to defaulting loans and downgrades on debt securities,
- rules for making new loans, and
- regulatory ratios.

Banks must also submit capital plans based on each scenario/stress tests. They must, in addition to the previous list,

- forecast expected capital sources and capital uses over the nine quarter horizon;
- describe methodologies that will be used to determine capital adequacy;
- submit a detailed capital policy plan;
- discuss expected changes to business plans that will affect capital adequacy and liquidity;
- show, for each scenario, that the bank will maintain minimum capital standards;
- explain how the bank will raise capital if necessary; and
- discuss plans for dividend payments, share repurchases, and other factors that may affect the bank's capital position.

Are ERM and capital planning one and the same? Perhaps not, but they are certainly intertwined. For example, a bank may explain, in CCAR reports, that it will issue **contingent convertible bonds (CoCos)** in the event of trouble. CoCos are preferred by regulators for a number of reasons. First, the bonds convert to equity if the bank is in capital trouble, easing the bank's cash outflows in times of stress. The conversion is triggered by accounting events, such as the level of Tier 1 capital, or market events, such as a drop in the bank's stock price. The bonds act as insurance for banks, thus a risk transfer from an ERM perspective. Also, because the bonds are less valuable after a shock, they may encourage less risk-taking and a stronger risk culture because executive compensation is exposed to downside risk. Also,

even though there is a transfer of risk with CoCos, it is not necessary to define the type of risk(s) in advance.

As of 2018, the minimum common equity Tier 1 capital ratio is 4.5%, the Tier 1 risk-based capital requirement is 6%, the total risk-based capital ratio is 8%, and the Tier 1 leverage ratio is 4%. Banks must meet these minimum standards under all scenarios. If a bank fails to meet minimum capital standards under stress testing, the bank must lower its risk appetite.

CCAR complexity is staggering. For example, the 2018 Federal Reserve scenarios encompassed 28 variables, ranging from the VIX (i.e., stock market volatility) to interest rates to gross domestic product forecasts to residential and commercial real estate indices. Banks then had to consider all other factors that might affect their portfolios. These variables, potentially numbering in the hundreds, could be anything from the slope of the yield curve to commodity prices to the state of land development values.

CCAR has required banks to engage in exercises that require business-line managers to come together and discuss risks, which is key to the ERM process. CCAR has helped banks understand risks by allowing scenarios to unfold over nine quarters (rather than point in time shocks), allowing interlinking factors (rather than siloed risks), and allowing risk factors to be dynamic. This means that banks can make capital plans as the scenarios unfold over time. Because banks are testing the same scenarios, regulators have a better sense of systemic risks. Also, regulators can better compare bank risk exposures (i.e., apples to apples), something that was nearly impossible when banks were each testing their own scenarios (i.e., apples to oranges).

Firms can even perform **reverse stress tests**. This means that a bank can identify worst-case outcomes on key performance indicators (KPIs). Banks can work backward to see which scenarios gave rise to these worst-case outcomes, allowing institutions to see which business lines are most vulnerable and/or contribute to bad outcomes. Key risk factors are highlighted in this exercise.

While many banks still view stress testing as a compliance issue, others are using the results to help specify risk appetites and risk limits, check the reasonableness of capital plans, develop warning signals, and put in contingency plans to manage liquidity, credit, funding and other risks. Stress tests that focus on macroeconomic factors can be used in day-to-day business planning at banks. Scenario analysis can be used in strategic decision-making. This is important as studies have shown that it is strategic blunders, not lapses in risk management, that account for a significant amount of enterprise value loss in public companies.

MODULE QUIZ 8.2

1. Luke Drake has been recently appointed as the chief risk officer (CRO) of a bank. Drake is looking to implement a comprehensive enterprise risk management (ERM) program and had several discussions with senior management on this topic. During one of these discussions, Drake made the following statements:

Statement 1: "Stress test scenarios should focus on the bank's ability to withstand historical shocks such as the Russian financial crisis of 1998 or the subprime debt crisis of 2008."

Statement 2: "In order for us to develop a successful ERM program, governance is important. This means senior management and the board of directors must engage in defining our risk appetite and risk and loss tolerance levels."

Is Drake correct regarding stress testing and corporate governance?

	Stress Testing	Corporate Governance
A.	Correct	Incorrect
B.	Incorrect	Incorrect
C.	Correct	Correct
D.	Incorrect	Correct

2. Allen Richards sits on the board of directors of a Canadian financial institution. Richards read the following statements in a presentation made to the board of directors by management on the institution's risk culture:

Statement 1: "As long as managers at business-line levels have the same risk appetite as the overall firm, the risk tolerance of the business-line employees is irrelevant."

Statement 2: "Hiring a chief risk officer will fix the risk culture problems we face at this institution."

Richards believes both of these statements are incorrect. Richards's assessment is accurate with respect to:

A. statement 1 only.
B. statement 2 only.
C. both statements.
D. neither statement.

KEY CONCEPTS

LO 8.a

An integrated and centralized approach under ERM is significantly more effective in managing a company's risks than under the traditional silo approach of managing risks within each risk/business unit. ERM is a comprehensive and integrated framework for managing a firm's key risks to meet business objectives, minimize unexpected earnings volatility, and maximize firm value. It is the best way to identify and prioritize risks.

LO 8.b

The key motivations of an ERM initiative include integration of risk organization, integration of risk transfer, and integration of business processes, which lead to increased organizational effectiveness, better risk reporting, and improved business performance, respectively. ERM also allows firms to focus on the largest risks facing them.

LO 8.c

A successful corporate governance framework requires that senior management and the board of directors adequately define the firm's risk appetite and risk and loss tolerance levels. Senior management and the board of directors should have the requisite organizational practices and processes in place to adequately control risks.

A strong ERM framework has five important dimensions: (1) targets, (2) structure, (3) identification and metrics, (4) ERM strategies, and (5) risk culture.

LO 8.d

The risk culture of a firm is the goals, customs, values, and beliefs (both implicit and explicit) that influence the behaviors of employees. These corporate norms guide individuals in their understanding and responses to risk. Individuals come to firms with their own ideas and views about risk and are influenced by peers, managers, and executives.

LO 8.e

Scenario analysis is used by banks to better understand and plan for risks. Firms and regulators develop narratives to test risks, explain why variables change, and understand the effects of those changes. Sophisticated financial models are developed to assess the impact of various scenarios on the risks and performance of the enterprise.

LO 8.f

Since the financial crisis of 2007–2009, regulators have required banks to use scenario analysis and stress testing in capital planning. U.S. stress testing of banks began in 2009 with the initial Supervisory Capital Assessment Program (SCAP). Since 2011, the Federal Reserve has conducted annual stress tests. In addition, the Dodd-Frank Act required stress testing (Dodd-Frank Act stress tests or DFAST) and the Comprehensive Capital Analysis and Reviews (CCAR) are conducted at year-end for banks with $50 billion or more in assets. While the scenarios for DFAST and CCAR are the same (devised by supervisors), DFAST is more prescriptive, requires less reporting, and has limited capital action assumptions. Results from stress testing are used to help banks in capital planning and maintaining capital adequacy.

ANSWER KEY FOR MODULE QUIZZES

Module Quiz 8.1

1. **A** The basis of enterprise risk management (ERM) is that risks are managed within each risk unit but centralized at the senior management level. The traditional approach to risk management was the silo approach, under which each firm unit was responsible for managing its own risks, setting its own policies and standards, without coordination between the business-line and risk units. ERM is a superior approach because management benefits from an integrated approach to handling all risks (for example, management can see risks within the firm that cancel out and, therefore, do not need to be separately hedged). It is common, but not necessary, to appoint a chief risk officer to oversee all risks under ERM. (LO 8.a)

2. **D** A strong ERM program allows a firm to focus on the largest risks facing the enterprise. Overhedging risks and taking out excessive insurance coverage are issues faced by companies that do not have an integrated ERM strategy. Managing risks at the business level is not an advantage of an ERM program. ERM programs use scenario analysis and stress testing, rather than sensitivity analysis, to assess potential threats. (LO 8.b)

3. **B** The firm's risk appetite and strategic goals in light of the risk appetite are the targets that must be set as part of an ERM program. (LO 8.c)

Module Quiz 8.2

1. **D** The first statement is incorrect in that it is backward looking. The Federal Reserve conducts stress tests and requires banks to consider baseline, adverse, and severely adverse scenarios, which may include historical variables but also include factors that have not necessarily happened before. The second statement is correct. Corporate governance requires managers, executives, and the board to be fully engaged in defining the firm's risk appetite and tolerable losses. (LO 8.f)
2. **C** Richards is correct with respect to both statements in that both statements are incorrect. Risk culture must infuse the entire organization, not simply business-line managers. Hiring a chief risk officer might signal a change in culture but will not "fix" all the risk culture problems. It might be perceived as window dressing or rebranding, with no real changes occurring with respect to the risk appetite and risk tolerances of the firm. (LO 8.d)

The following is a review of the Foundations of Risk Management principles designed to address the learning objectives set forth by GARP®. Cross-reference to GARP FRM Part I Foundations of Risk Management, Chapter 9.

Reading 9

LEARNING FROM FINANCIAL DISASTERS

Study Session 3

EXAM FOCUS

This reading examines case studies that have resulted in financial crises. Specifically, these cases illustrate past failures caused by interest rate risk, liquidity risk, model risk, the risk of a rogue trader's actions, reputation risk, cyber risk, and the risk associated with financial engineering and corporate governance failures. For the exam, understand the differences between the risk mitigation options of a static hedge and a dynamic hedge. Also, pay close attention to the causes of the financial disasters presented in the various cases and how they could have been prevented.

LO 9.a: Analyze the key factors that led to and derive the lessons learned from case studies involving the following risk factors:

- **Interest rate risk, including the 1980s savings and loan crisis in the U.S.**
- **Funding liquidity risk, including Lehman Brothers, Continental Illinois, and Northern Rock.**
- **Implementing hedging strategies, including the Metallgesellschaft case.**
- **Model risk, including the Niederhoffer case, Long Term Capital Management, and the London Whale case.**
- **Rogue trading and misleading reporting, including the Barings case.**
- **Financial engineering and complex derivatives, including Bankers Trust, the Orange County case, and Sachsen Landesbank.**
- **Reputational risk, including the Volkswagen case.**
- **Corporate governance, including the Enron case.**
- **Cyber risk, including the SWIFT case.**

MODULE 9.1: CASE STUDIES ON INTEREST RATE RISK, LIQUIDITY RISK, AND HEDGING STRATEGY

Interest Rate Risk

Interest rate risk is the potential for loss due to fluctuations in interest rate levels. The degree of sensitivity to interest rate risk is classically measured with **duration**. The

magnitude of this risk can be illustrated using an example of the **savings and loan (S&L) industry** in the 1980s. All commercial banks, S&Ls included, accept short-term demand deposits from customers and use those funds to make long-term loans. Their goal is to capture the spread between the rate paid for short-term deposits (liabilities from the bank's perspective) and the rate received on longer-term loans (assets from the bank's perspective).

The savings and loan crisis was a complex event that illustrates the impact of unmanaged interest risk on a firm and potentially an entire industry. Originally established in 1933, Regulation Q was extended to S&Ls in 1966. This rule enabled S&Ls to limit the interest paid on short-term deposits (i.e., checking accounts), which allowed them to maximize the interest spread between the deposits from customers and the 10-year mortgages that were very common with S&Ls. During the late '60s and early '70s, the yield curve was upward sloping, which meant that short-term rates (a cost for S&Ls) was much lower than longer-term rates (a profit center for S&Ls). Banks could effectively "ride the curve" and profit from the positive interest rate spread. In the late 1970s, inflation surged and the Federal Reserve responded by raising interest rates. This reality weakened strong lending margins to the point where losses began to mount. Imagine paying customers 6% on short-term deposits and receiving only 5% on long-term mortgages. Savings and loan operators accounted for this negative profit spread by lower lending standards and getting into some very risky loans. They ended up losing so much money that the American taxpayers had to engage in a $160 billion bailout of the industry and roughly 35% of the S&Ls were immediately out of business.

Lessons can be learned from observable failures. The S&L crisis brought interest rate risk to the forefront of discussion and encouraged risk-relative thinking. Banks have some tools to manage the interest rate risk inherent in their business model. One option is to match the duration of their short-term liabilities and their long-term assets. If the assets and liabilities are correlated and they have an approximately similar duration, then their movements will offset each other as interest rates fluctuate. Another option is to hedge known interest rate risk using a derivatives product (e.g., caps, floors, swaps).

Liquidity Risk

Liquidity risk is the risk that an entity might not be able to meet short-term cash requirements. This risk can materialize from external market conditions, from internal operational issues, from structural (i.e., balance sheet) challenges, or from a mix of these three. What follows are a series of case studies related to liquidity risk.

Lehman Brothers

Lehman Brothers was an investment bank that was founded in 1850. In the early 2000s, it invested heavily in securitized U.S. real estate assets. This company was very active in the process of sourcing loans, repackaging them as securitized assets, and selling them to investors. It also retained large portions of these securitized assets on its balance sheet. Lehman Brothers continued to be actively involved in the securitized mortgage market even after housing prices began to decline in 2006.

The funding model deployed by Lehman Brothers amplified its challenges relative to the eventual collapse of the housing market. All banks use leverage where they source new

assets (i.e., loans or securitized loan products) and often use debt to fund the new assets rather than customer deposits or internal capital. By 2007, Lehman Brothers had leverage (an asset-to-equity ratio) of 31:1. Its core funding strategy was to borrow in the short-term (i.e., daily repo) markets and use these short-term borrowings to fund the long-term and relatively illiquid securitized assets. The housing bubble had clearly burst by the second half of 2007, and investors became increasingly unwilling to lend Lehman (and other market participants) money in the short-term markets. In the early hours of Monday, September 15, 2008, the CEO of Lehman Brothers announced that reality had caught up with their business model, and the company was forced to file for bankruptcy. In that moment, a 150-year-old company was out of business because senior management did not adequately manage the bank's liquidity risk.

Continental Illinois

Continental Illinois was at one time the largest bank in Chicago. The result of a merger in 1910, this bank aggressively pursued both commercial and industrial loans. In the late 1970s, the bank was one of the big players in the oil and gas market. Another bank (Oklahoma-based Penn Square Bank) was actively sourcing oil and gas loans from the Oklahoma natural resources exploration industry. Penn Square could handle small loans, but it sent all larger deals to a partner such as Continental Illinois, which was one of the 10 largest banks in the United States. In 1981, the energy market experienced a significant downturn and Penn Square Bank became insolvent. At this point, Continental held approximately $1 billion of Penn Square-linked loans, which led to large losses.

Compounding this issue was Continental's business model that relied upon borrowing short-term money from the Federal Reserve and selling certificates of deposit (CDs). These funding sources proved to be insufficient to meet Continental's growing liquidity needs, so it resorted to the high-rate lending environment in foreign (e.g., Japanese) money markets. Awareness of Continental's funding challenges reached the foreign markets in May 1984. At this point, the bank became unable to borrow even at these higher rates, and depositors withdrew about 20% of the bank's demand deposits over the span of just 10 days. The bank quickly failed and became the largest bank rescue effort in the history of the Federal Reserve Bank up to that time. Some have said that it was Continental Illinois that first necessitated the use of the term "too big to fail."

Northern Rock

Northern Rock was a fast-growing mortgage-focused bank in the United Kingdom. For many years leading up to the financial crisis of 2007-2009, Northern Rock had been growing assets (i.e., loans) at 20% per year. Its business model was a little unusual in the British market because it deployed an **originate-to-distribute (OTD) model** (i.e., source loans with the goal of repackaging and selling them).

Its source of funding for these ventures was money borrowed in the short-term markets. Because it was based in the United Kingdom, Northern Rock accessed a globally diverse funding market (i.e., its funding sources were in the U.S., Europe, and Asia). The rising default rates in early 2007 eventually rippled through the global market for securitized mortgages.

Ironically, just before the trouble began, British regulators provided Northern Rock with a Basel II waiver, which allowed it to pay increased dividends to shareholders.

When the full intensity of the financial crisis came to bear, the Bank of England internally decided to provide support for the troubled lender. When news of this support leaked to the public, anyone who had demand deposits with Northern Rock quickly rushed in to withdraw what they could. At the time, British law only guaranteed deposits up to £2,000 with an additional 90% guarantee up to £33,000. British regulators told the public that it would guarantee 100% of all deposits at Northern Rock and the run on the bank slowly subsided, but the bank had to turn itself over to public ownership in the process.

Lessons Learned From Liquidity-Linked Crises

In the wake of the financial crisis of 2007 to 2009, the Federal Reserve began to require periodic stress testing for all large U.S.-based banks. This process pushed banks to consider liquidity risk mitigation in the form of either **asset/liability management (ALM)** or the use of derivatives, such as interest rate swaps.

There are two key tradeoffs inherent with the ALM process. The first relates to liquidity and interest rate risk. Banks that seek to minimize interest rate risk, by having funding sources with lower durations than their assets (i.e., loans), will have higher liquidity risk. The second tradeoff relates to cost versus risk mitigation. Lessening liquidity risk means that the duration of liabilities needs to closely match that of loan assets. Essentially, this means moving funding sources to longer-term, more expensive sources of capital.

A competing option is for banks to reduce the maturity on their assets (i.e., loans). This action may not be realistic, depending on market forces. Loan tenures are often shaped by borrower needs and competitive pressures.

It may not be possible for banks to exactly coordinate the durations of their liabilities and assets. This creates the need for emergency liquidity access. This could take the form of credit lines with designated lenders. Pursuing this option could be costly if the credit lines are not needed and fees are paid regardless. Banks must balance the risk reduction gained from securing emergency funding sources with the cost of securing this backstop.

Hedging Strategies

Devising an effective hedging strategy is a challenging and potentially rewarding undertaking. It requires access to relevant data, access to appropriate statistical tools, and the right model for the analysis task at hand. Once a firm decides that it wants to hedge a known risk, it needs to decide if it wants to deploy a static or a dynamic strategy.

A **static hedging strategy** involves buying a hedging instrument that closely matches the position to be hedged. The relationship is only measured at the time that the hedge is deployed. There is no effort to adjust a static hedge, which means that the focus is on the results at the strategy's horizon (i.e., maturity). This option requires relatively low supervision and incurs relative low transaction costs. These benefits come with the drawback of not adjusting the hedge for changes in the underlying exposure.

A **dynamic hedging strategy** deploys a hedging instrument and then rebalances the hedged position on a frequent basis (e.g., daily, monthly, quarterly). While this option does match hedging needs more closely with changing market forces, it requires ongoing supervision and it can be costly from the perspective of transaction costs. There is also an added element of model risk associated with a dynamic strategy.

Incumbent on a dynamic hedge is the concept of periodically updating the hedging exposures. This can be thought of as a **rolling hedge**, in which analysts will buy one-month futures contracts to hedge a long-term exposure. When the first month has passed, they will need to roll forward the strategy and buy another series of one-month contracts. This process is repeated until the strategy's horizon has been reached.

Metallgesellschaft Refining and Marketing (MGRM), an American subsidiary of an international conglomerate, presents an interesting case study on dynamic hedging deploying a rolling hedge strategy. In 1993, it implemented a marketing strategy designed to insulate customers from price volatility in the petroleum markets, for a fee.

MGRM offered customers contracts to buy fixed amounts of heating oil and gasoline at a fixed price over a 5- or 10-year period. The fixed price was set at a $3 to $5 per barrel premium over the average futures price of contracts expiring over the next 12 months. Customers were given the option to exit the contract if the spot price rose above the fixed price in the contract, in which case MGRM would pay the customer half the difference between the futures price and the contract price. Customers might exercise this option if they did not need the product or if they were experiencing financial difficulties. In later contracts, customers could receive the entire difference in exchange for a higher fixed contract price.

This process left MGRM exposed to the risk of rising energy prices. The customer contracts effectively gave the company a short position in *long-term* forward contracts. MGRM hedged this exposure with long positions in *short-term* futures using a **stack-and-roll hedging strategy**. The company used short-term futures for hedging because alternatives in the forward market were unavailable, and long-term futures contracts were highly illiquid. As it was, MGRM's open interest in unleaded gasoline contracts was 55 million barrels in the fall of 1993, compared with average trading volume of 15 to 30 million barrels per day. Using this approach, the firm hedged its long-term exposures with one-month futures contracts. Every month, it would need to sell its current contracts before expiration and buy a new batch of one-month futures to hedge any in-force contracts.

PROFESSOR'S NOTE

Gains and losses on forward contracts are realized at the agreement's expiration, whereas futures contracts are marked to market such that the gains and losses are realized on a daily basis. In MGRM's case, gains and losses on its customer contracts were realized if and when the customers took delivery, which would occur over a 5- to 10-year period.

This rolling hedge strategy could yield profits on the hedging instruments if the curve of futures prices is in **backwardation**, which means that the spot (i.e., immediate delivery) price is higher than the price for future delivery. Under a backwardation regime, existing futures contracts could be sold at a profit relative to the cost of buying the next month's hedges. The alternative environment is known as **contango**, and this occurs when future

delivery prices are higher than spot prices. Contango results in losses when implementing a rolling hedge strategy.

In late 1993, spot oil prices declined sharply. The result of this contango was a $1.3 billion margin call to offset unrealized losses. The company did not have cash to cover this substantial paper loss (because its customer contracts were all long-term in nature), and the parent company directed the MGRM to close out all hedging positions. This move essentially turned an unrealized loss into a realized one. MGRM may have been able to survive had it secured short-term funding sources to help meet margin call needs. This is an excellent case study in how a company used a rolling hedge strategy that created liquidity risk, which ultimately proved to be its undoing.

Although some market observers cite the maturity mismatch between MGRM's short position in long-term fixed-rate contracts with customers and its long position in near-term futures contracts, many economists believe this hedging strategy is fundamentally sound. Over the life of a properly constructed hedge, the cash flows from the forward and futures contracts would balance out, provided the hedging firm could withstand interim cash flow requirements from marked-to-market losses, margin calls, credit risks, and liquidity risks associated with adverse market movements. The fundamental issue for MGRM was a cash flow problem that constrained the company's ability to ride out the hedge.

Three considerations need to be discussed relative to deploying a rolling hedging strategy. First, there are accounting rules that may make this strategy less advantageous from a financial statement perspective. According to German accounting rules (following the International Financial Reporting Standards [IFRS]), MGRM was required to report losses associated with its futures contracts but was not permitted to show associated daily gains from its customer contracts. Recording massive losses on the income statement could affect a firm's credit rating and, therefore, its ability to conduct business in general. Second, when a firm needs to unwind a large futures position, it may take several days (in MGRM's case, 10 days) to sell contracts while minimizing market impact to not make the problem even worse. This consideration adds an element of *trading liquidity risk* to a scenario previously focused on *funding liquidity risk* (mismatch of short-term contracts with long-term liabilities). Third, tax treatment on hedging instruments varies between jurisdictions. The after-tax impact could be very different from the pretax outcomes.

MODULE QUIZ 9.1

1. Which of the following methods is not a way in which banks can mitigate interest rate risk?
   A. Use swaps.
   B. Use floors and caps.
   C. Extend loan assets to longer terms.
   D. Match the duration of the bank's assets and liabilities.
2. How is liquidity risk dangerous for a bank?
   A. Liquidity risk positively correlates with interest rate risk.
   B. Liquidity risk results from using costly long-term funding sources.
   C. When long-term assets are funded with short-term liabilities, trouble is waiting if the funding sources evaporate.
   D. When long-term liabilities are funded with short-term assets, trouble is waiting if the funding sources evaporate.

3. Which of the following statements is correct regarding the implementation of a hedging strategy?
    A. Dynamic hedges require active supervision.
    B. Dynamic hedges require the use of one-month futures contracts.
    C. Static hedges are the best option for a rapidly changing market environment.
    D. Static hedges require that the hedging instrument exactly match the position to be hedged.

MODULE 9.2: CASE STUDIES ON MODEL RISK AND ROGUE TRADING

Model Risk

Sophisticated financial products use mathematical models to determine their current value. These models could be theoretical (e.g., capital asset pricing model [CAPM]) or statistically based (e.g., term structure of interest rates). The use of models introduces model risk, which potentially involves the following:

1. Using the wrong model for estimation
2. Incorrectly specifying a model
3. Using incomplete data
4. Deploying the wrong estimators
5. Making the wrong assumptions

The following three case studies offer good illustrations of the potential impact of model risk. From the Niederhoffer case, you will learn about the implications of wrong assumptions. From the Long-Term Capital Management case, you will learn the need to plan for risk metrics beyond 10-day value at risk (VaR) and a need to conduct stress testing with an eye to weathering short-term liquidity vacuums. From the London Whale case, you will learn that when risk limits are breached or trades look unprofitable, risk managers should never adjust assumptions or valuation models to make bad decisions look better.

Niederhoffer Case

Victor Niederhoffer was a very successful hedge fund trader. He developed what he thought was a low-risk strategy to harvest put option premiums. He would write very large quantities of deeply out-of-the-money (OTM) put options on the S&P 500 Index. As long as the daily drop in the S&P was less than 5%, he would capture small premiums offered by these OTM puts. Historically, this 5% threshold was very realistic (assuming a normal distribution, a 5% decline should have been a near impossibility in the mid-1990s). However, in October 1997, a crisis in Asia spilled over to the U.S. markets and produced a 7% drop in a single trading session. The result was a $50 million margin call, which Niederhoffer could not meet. His fund's brokers liquidated all put contracts, which locked in substantial losses and wiped out the entire fund's equity position. The lesson to be learned is that assumptions can be flawed and that competitive markets never offer a free lunch.

Long-Term Capital Management

Long-Term Capital Management (LTCM) was founded in 1994. The hedge fund's principals included former Federal Reserve Board Vice-Chairman David Mullins, Nobel laureates Robert Merton and Myron Scholes, and a collection of highly experienced traders from Salomon Brothers' bond arbitrage trading desk. Before LTCM's collapse in the late 1990s, it had $4.8 billion in equity and $125 billion in assets. This translated into a 26:1 leverage ratio. A 1% return on from its core strategy (i.e., spread normalization) would feel like a 26% gain for the levered fund. This **balance sheet leverage** does not account for the true underlying **economic leverage**. The notional value of LTCM's assets was over $1 trillion at this time! The staggering use of leverage was possible because financial institutions often waived initial margin requirements based on the reputation of the principals, freeing up capital to take on even more leverage.

LTCM's core strategy was a relative value play. In a simplistic sense, this strategy involves buying one asset and selling another in an attempt to capture a perceived mispricing between the two assets. Conceptually, a relative value strategy should reduce both volatility and systematic (i.e., market-linked) risk. This type of strategy will profit when the spread moves in the desired direction, regardless of overall market direction. Using this approach, the academics and experienced traders directing the bets of LTCM constructed trades that appeared safe from a statistical perspective.

More specifically, LTCM was playing perceived spread differentials between either sovereign and corporate bonds or between issues from different governments. One example was when they bought British corporate bonds and shorted an appropriate amount of British government sovereign debt. The goal was to capture a wider than normal spread difference. They also tried to exploit opportunities flowing from the planned entrance of certain countries into the European Union (EU). They bought Spanish and/or Italian sovereign bonds and shorted German bunds. They had similar plays that also used U.S. Treasuries as the short target.

Long-Term Capital Management's downfall was triggered by an action of the Russian government in August of 1998. In a surprise move, the Russians defaulted on their own debt and devalued their currency. This created a *flight to quality* (i.e., an extreme movement to assets perceived as safe) where investors rushed to buy the exact assets that LTCM had been shorting (i.e., U.S. Treasuries and German bunds). The result was a decline in the value of LTCM's assets by just over 40% ($2 billion of their $4.8 billion in equity) in one month. The turmoil that ensued spilled over into the broader U.S. financial markets and nearly caused a systematic crash. It probably would have if the Federal Reserve Bank of New York had not stepped in to broker a deal where a group of banks would inject $3.5 billion of new equity in LTCM in exchange for 90% of the firm's shares and complete control of management.

PROFESSOR'S NOTE

Notice the similarity to the funding liquidity risk between LTCM and the Metallgesellschaft case. They both reached a breaking point due to lack of short-term liquidity.

The failure of LTCM was due to model error. Management did not properly anticipate increased correlations in the event of a global crisis. They actually adjusted correlations higher in their models, but the adjustment did not go anywhere close to the actual correlation spike caused by the cascading external economic shocks. They also did not

properly forecast the volatility that actually appeared in the markets. The margin calls that resulted from the evaporation of their equity drove LTCM to the point of collapse. In fairness, it was (and is) very difficult to forecast extreme tail risk events like the Russian devaluation scenario. Ironically, LTCM's original investment thesis played out just fine in the medium term. The banks who rescued them with an infusion of much-needed cash ended up making substantial returns. The model risk led to a liquidity risk crisis for LTCM, which ultimately destroyed the company.

There are a few specific lessons that can be learned from the LTCM case study. They are itemized as follows:

- *Monitor correlations*. Not only did geographic diversification fail due to elevated correlations, but the correlations between bonds and stocks also rose during a period of unexpected external shock. The models deployed assumed that low-frequency/high-severity events were uncorrelated over time.
- *Watch liquidity*. When turmoil arrived, LTCM could not weather the short-term storm to reap the medium-term gains because it did not have adequate liquidity. This was partly due to its very high leverage levels and partly due to market conditions. The extreme leverage enabled it to assume extremely large, high-profile positions that attracted the attention of imitators. When it became necessary to liquidate positions, LTCM found itself competing for market liquidity with imitators who were also liquidating their positions. The market impact was amplified and a systematic mini-crisis ensued until a bailout was arranged.
- *Consider loss assumptions*. LTCM relied heavily on value-at-risk (VaR) modeling using a 10-day time horizon. Its calculated VaR was $320 billion and reality played out much more severely. A 10-day horizon is far too short of a window to survive a short-term market shock. Stress testing is a better approach, which is now advocated for by both the Federal Reserve and the Basel accords.
- *Enhance disclosure*. Because LTCM was structured as a hedge fund, it was not required to disclose much of the details of its positions. From an accounting perspective, it did daily marking-to-market. LTCM also provided enough disclosure on its financial statements to comply with requirements, but the real meat of the strategies was not adequately disclosed.
- *Require initial margin posting without exception*. Had LTCM's lenders been consistent in requiring the posting of initial margin when leverage was applied, LTCM probably would not have enjoyed such a high level of leverage. There also would have been a cushion to buffer the short-term liquidity crisis.

The London Whale Trade

JP Morgan is one of the largest financial holding companies in the United States. It is also one of the largest derivatives dealers (particularly credit derivatives) in the world. In early 2012, its chief investment officer (CIO) was tasked with managing $350 billion in excess demand deposits. It used this money to make massive bets on synthetic credit derivatives that ultimately cost the bank $6.2 billion in trading losses and temporarily disrupted global markets.

PROFESSOR'S NOTE

JP Morgan's London office handled its synthetic derivatives transactions. One trader, Bruno Iksil, was known to place such huge trades (relative to the previously existing market) that he was known as "The Whale."

In early 2011, the bank realized that it needed to reduce risk in order to satisfy regulatory capital requirements. Rather than downshifting the volume of its short bets, the CIO's leadership decided to double down with long bets to conceptually offset the risk in short holdings. Doing so effectively negated much of the risk management goals involved with taking the short positions in the first place. Instead of decreasing risk exposure (i.e., the stated objective from upper management), this strategy actually expanded risk exposure in pursuit of profit.

Calendar year 2012 opened with losses in the CIO's strategies. Rather than adjust the economic impact of their trades, leadership decided to adjust the valuation methodology of their synthetic derivatives. Best practice is to use the midpoint of the daily trading range as the valuation anchor. By the end of January 2012, the CIO was now using an assigned price (i.e., cherry picking) from anywhere within the daily range that made the position appear less risky for internal controls. In March 2012, this practice was discovered when JP Morgan's own investment bank realized that the CIO and the investment bank divisions were valuing the synthetic derivatives two different ways. In May 2012, JP Morgan's deputy chief risk officer directed the CIO to return to using the midpoint valuation method as verified by an independent third party. This ethical instruction began to accrue both economic and accounting losses for JP Morgan.

Throughout this time line, the CIO was routinely breaching (and disregarding) internally established risk limits. According to a U.S. Senate review of the Whale Trade in 2013, the CIO ignored 330 breaches of its VaR-established risk limits between January 1, 2012 and April 30, 2012[1]. These breaches were systematically either ignored or addressed by raising risk limits. The CIO devised a series of revised VaR assumptions that decreased calculated VaR by 50%. Unfortunately, the economic reality of a $6.2 billion loss was not avoided as easily as these assumptions were changed. On May 10, 2012, the bank realized the error in adjusting these assumptions and reversed the changes, but the dollar loss for JP Morgan's shareholders and the short-term impact on global financial markets remained.

Rogue Trading

Barings Bank was founded in London in 1762, and it was the world's second-oldest merchant bank. In 1992, an employee named Nick Leeson moved to Singapore to become the local head of operations. His mission was to execute client trades on the Singapore stock exchange. Leeson's role expanded to conducting proprietary arbitrage trades exploiting perceived pricing differentials on futures contracts listed concurrently on the largest stock exchange in Japan (i.e., the Nikkei) and the second largest stock exchange in Japan (i.e., the Osaka Securities Exchange). A traditional arbitrage trade involves taking a long position in a potentially underpriced security and a short position in a potentially overpriced one. For whatever reason, Leeson decided to take the rogue action of speculating in a directional move by only buying one asset without an offsetting short position.

From an accounting perspective, Leeson's trading actions looked like they were making a large return for Barings Bank. The reality was that Leeson also controlled the back-office accounting of his own trades, and he managed the reporting through a hidden reconciliation account that was never reported to the home office. What appeared to be a £102 million profit in 1994 was actually a £200 million loss.

In late 1994, the risk managers at Barings Bank grew curious about the unusual gains that Leeson was producing relative to the types of trades he was making. Unfortunately, they were not in a position to override Leeson's supervisors who were comfortable with his trading activity. Their comfort level was likely influenced by their supersized bonus checks as a result of the trades. Risk managers continued their interest when, in January 1995, Leeson reported an unusual profit of £10 million in a single month. Once again, their concerns were dismissed.

When upper management at Barings Bank learned what Leeson was actually doing, it was too late. The actual losses grew so large that the bank was forced to liquidate. A Dutch Bank, ING, acquired Barings Bank. In that moment, a roughly 200-year-old banking titan was decimated and sold for £1 because a rogue trader was permitted to act unchecked.

The lesson to be learned from this case with Barings Bank is both simple and profound. If something appears too good to be true, then it should be questioned. All amazing results should be treated with a degree of healthy skepticism. If profits appear to be either outsized or strangely consistent, then scrutiny is needed to ensure that the books are being kept correctly. There should also be an independent verification mechanism, and the back-office should never be controlled by front-office (i.e., traders) influencers. Trades also need to be judged relative to their ultimate outcome, not based on isolated sections of the full holding period.

MODULE QUIZ 9.2

1. Which of the following statements is not a lesson that risk managers should learn from the Long-Term Capital Management case study?
   A. Short-term VaR parameters are always the best risk management tool.
   B. There should be no exceptions to initial margin requirements imposed by lenders.
   C. Position liquidity should be carefully monitored, especially when using extreme leverage.
   D. Correlations are a great way to consider asset allocation, but they need to be monitored for convergence during periods of stress.
2. Which of the following actions is not a step that could help prevent a rogue trader from destroying an entire business?
   A. Maintain separation between supervision of back-office and front-office operations.
   B. Treat all expectation-beating results with a degree of healthy skepticism.
   C. Monitor trading profits that are reported to be consistent over time.
   D. Measure all trading activity over short periods of time and not over the tenure of the trade.

MODULE 9.3: CASE STUDIES ON FINANCIAL ENGINEERING, REPUTATION RISK, CORPORATE GOVERNANCE, AND CYBER RISK

Financial Engineering

The building blocks for financial engineering are forwards, futures, swaps, options, and securitized products. By using these tools, a risk manager could hedge either a granular risk exposure or a basket of risk exposures. Consider a U.S.-based mutual fund that invests in Japanese fixed income instruments. Among other factors, they are exposed to Japanese interest rate risk and currency risk as well. The managers could choose to hedge one of these risks using forwards and/or swaps. They could also use a **quanto swap**, which is a multicurrency interest rate swap.

Risk managers need to be careful about which goal a hedging strategy is pursuing. In its purest sense, a hedging strategy can be used for risk mitigation. Alternatively, some firms have used hedging strategies to enhance returns. This second strategy usually adds more layers of risk rather than mitigating current exposures.

Bankers Trust

In the early 1990s, **Bankers Trust** (BT) was known to be a skilled risk manager. For this reason, Proctor & Gamble (P&G) approached BT to help manage interest rate risk in both U.S. dollars and deutsche marks (the German currency at the time). After discussion with Bankers Trust, P&G decided to bet on an interest rate decline using complex leveraged swaps. At one point, it was leveraged 20:1 in a series of swaps where BT would pay P&G a fixed rate in return for a floating-rate payment from P&G. Things went just fine at first, but then the Federal Reserve began to raise interest rates (by 250 basis points) in 1994. This unexpected change cost P&G a substantial sum of money, in part, because it chose to be speculators and not just hedge risk exposures. Its leverage amplified the losses. P&G ultimately sued BT and won a judgment of $78 million. Several other firms had a similar experience with Bankers Trust and the resulting reputational damage was too much to overcome. BT was eventually acquired by Deutsche Bank.

Orange County

Repurchase agreements (i.e., repos) are a short-term borrowing mechanism where one party sells a security to a counterparty and agrees to repurchase it, at a later date, for a slightly higher price. The price increase is the "interest" on the transaction. In the early 1990s, California's Orange County had $7.7 billion in assets. Its treasurer, Robert Citron, used short-term repos to borrow an additional $12.9 billion. Citron subsequently invested all assets and all borrowed funds into complex inverse floating-rate notes. These securities have coupon rates that decline when interest rates rise. Orange County was completely reliant on lenders being willing to roll forward the repo contracts when they matured (i.e., a maturing repo was replaced with a new repo contract rather than paid for with cash). Initially, this strategy allowed Citron to earn 2% higher than his peers. However, when the Federal Reserve raised interest rates by 250 basis points in 1994, Orange County's strategy fell apart when coupon rates dropped on the complex derivatives and investors did not roll forward Orange County's repo products. This ultimately resulted in a bankruptcy filing. Citron later admitted that he really did not understand the risk exposures of inverse floaters. The lesson is to not invest in anything that you do not understand because the losses can be terminal.

Sachsen Landesbank

In Germany there are a series of publicly owned banks known as Landesbanks. They specialize in lending to regional small- and medium-sized firms. In the mid-2000s, the Landesbanks saw the profit potential in the U.S. subprime lending market. They began to establish off-balance sheet entities in other countries that could hold securitized subprime mortgage loans. Sachsen Landesbank was one such bank. It created an off-balance sheet entity domiciled in Dublin, Ireland, and bought a large amount of subprime assets. When the financial crisis of 2007-2009 struck, Sachsen sustained such heavy losses that it had to sell itself to another German bank that had not pursued the alluring profits of securitized subprime mortgage products.

Reputation Risk

A company's reputation is a public perception of its fairness, commitment to ethical behavior, and treatment of stakeholders (i.e., customers, suppliers, counterparties). One trending area with growing reputational influence is environmental, social, and governance (ESG) monitoring. **Reputation risk** is the potential for negative operational outcomes due to a poor public perception (ESG or otherwise). The three big constituents to watch are customers, regulators, and shareholders. In the internet era, it is very easy for facts and rumors to be distributed to the general public. Even a bad rumor can temporarily destroy a firm's reputation in a matter of hours. The most damaging situations occur when the rumors are true.

Volkswagen

In September 2015, the U.S. Environmental Protection Agency (EPA) announced that Volkswagen (VW) had been unethical in its environmental responsibilities. It violated the ESG ethos by programming the software on its vehicles to only control emissions during regulatory tests. This meant that Volkswagen vehicles passed all emissions screens with flying colors, but the software stopped controlling emissions when the cars were in everyday use by consumers. Between 2009 and 2015, this software management affected over 10 million cars worldwide.

The reputational damage to VW was fast and furious. Its share price was cut by one-third as the scandal unfolded. Volkswagen faced billions of dollars in potential fines on top of decreased sales as consumers responded to the allegations by switching brand loyalty to other vendors. At one point, the German government even expressed concern that the imprimatur "Made in Germany" might suffer reputational damage in the aftermath of an epic lapse in judgment.

Corporate Governance

Corporate governance is a system of policies and procedures that direct how a firm is operated. Governance checkpoints include adequate transparency and accountability, supervision of senior leaders and risk management policies, deploying reasonable diversity, ensuring board member independence, and representation of required skillsets for the company in question. Sometimes, a concept is best learned when considering what not to do. Enron is the poster child for corporate governance failures.

Enron

In 1985, the highly leveraged merger of InterNorth and Houston Natural Gas gave birth to **Enron**. A subsequent wave of deregulation moved Enron into the role of being a gas broker. The company would routinely purchase gas from various vendors and sell it to a network of customers at predetermined prices. To cover its risk exposure to gas prices, Enron created a new market for energy derivatives. As a result, Fortune magazine named Enron "America's Most Innovative Company" from 1995 through 2000. At the end of the year 2000, Enron had 20,000 employees and nearly $101 billion in recorded revenue.

Reality caught up with Enron in December 2001, which is when it became the largest bankruptcy in U.S. history. This was a direct result of massive corporate governance failures and a textbook example of agency risk. The various failures are listed as follows:

- *Agency risk*. Enron's senior management put self-interest above other stakeholders. They pursued short-term profitability to maximize personal wealth and sacrificed the entire firm in the process.
- *Lack of board oversight*. Ken Law was both the chairman of the board and the CEO. He was effectively supervising himself. The board also allowed Enron's chief financial officer (CFO) to operate his own private equity firm as a side business. This was a business in name only and served the function of funneling even more money to the CFO's personal control.
- *Accounting fraud*. Enron used special purpose vehicles (SPVs) and other creative accounting tricks to commit outright fraud. It would create fake sales and then move any resulting losses to an SPV to hide them from public scrutiny.
- *Revenue recognition practices*. The company would routinely construct a physical asset and recognize it as revenue as soon as production was complete (regardless of whether an actual sale occurred). Any losses when an actual sale happened were buried in an off-balance sheet SPV.
- *Auditor failure*. Arthur Anderson was one of the big five accounting firms. It was the sole auditor for Enron. Congressional inquiry later discovered that Arthur Anderson was implicit in this fraud and revoked its ability to practice accounting. Enron's fraud caused both firms to fail.

As is typically the case, the result of this crisis was a new piece of regulation. Enron's failure was the fuel needed to bring Sarbanes-Oxley (SOX) to life in 2002. This law requires accountability for key corporate officers relative to the reliability of reported financial statements. It also created the Public Company Accounting Oversight Board (PCAOB), which holistically promotes a high standard for corporate governance.

Cyber Risk

Cyber risk is the risk of financial or reputational loss resulting from a breach in internal technology infrastructures. This risk revolves around a hacker accessing systems that result in theft of money, information, or identity data (i.e., Social Security numbers, emails, passwords) of customers and employees. Corporations spend billions of dollars every year to ensure the integrity of the technology systems, and some even purchase cyber insurance to outsource the risk of loss to a third party.

The SWIFT Case

The **Society for Worldwide Interbank Financial Telecommunication (SWIFT)** is the global leader in electronically transferring funds between financial institutions. It is supervised by a consortium of central bankers from Belgium, the United States, England, the European Central Bank, Japan, and others. If a business needs to move a sum of money from a bank in Tokyo to a bank in Berlin, then SWIFT will be the vehicle used to transfer the money. It conducts between 25 and 35 million transactions every day.

In February 2016, hackers accessed the SWIFT system and stole $81 million from the Bangladesh Bank (the central bank of Bangladesh). This money was on deposit with the New York Federal Reserve Bank. The access was through the use of employee credentials (how these employee credentials were obtained was never fully resolved) and a series of requests to transfer funds to various locations throughout Asia. No longer were face masks and weapons needed to rob a bank. The goal was to steal $1 billion, but the Bank of New York stopped all transfers after discovering a typo ("fandations" instead of "foundations") in one of the otherwise legitimate-looking requests. After the $81 million was transferred to a bank in the Philippines, the hackers used malware to delete the record of the transfer and disable transaction confirmation notifications. When the Bangladesh Bank realized that it was not receiving any transfer notifications, it rebooted their system and immediately received a flood of transfer notices, which brought the cyber theft into the light. The money was never recovered because it was transferred from the bank in the Philippines to a series of casinos and promptly withdrawn. This was a sophisticated cyberattack and it illustrates the stakes involved in ensuring security for IT systems.

MODULE QUIZ 9.3

1. Which of the following scenarios most likely presents a reputation risk?
   A. The CFO of a regional bank announced that it is using financial engineering to manage risk.
   B. A risk manager buys one asset and sells another in an attempt to capture a perceived mispricing between the two assets.
   C. A regional manufacturer is rumored to be replacing all plastic packaging with biodegradable and recycled products.
   D. The unmonitored equipment of an electric utility is rumored to be the cause of a series of wildfires that caused significant damage.
2. Which of the following statements is not a lesson learned from the collapse of Enron?
   A. Independent and ethical auditors are needed as a double check to mitigate agency risk.
   B. The roles of chairman of the board and CEO should be separated for enhanced accountability.
   C. The best way for a company to avoid fraud is for the CEO and the CFO to be in constant contact regarding internal policies.
   D. Aggressive accounting techniques should be highly scrutinized by investors, or the target company should be avoided as a potential investment.
3. Which of the following statements is correct regarding cyber risk?
   A. Cyber risk is only a danger for banks.
   B. Cyber risk must be retained and mitigated with internal resources.
   C. Cyber risk is becoming less of an issue due to the impact of regulation.
   D. Cyber risk involves the potential for loss resulting from a technology-related breach.

KEY CONCEPTS

LO 9.a

Interest rate risk flows from fluctuations in interest rate levels. This sensitivity can be measured using duration. The S&L crisis in the 1980s highlighted the veracity of interest rate risk. Banks received deposits from customers and then lent that money for longer-term loans. Their goal was to capture the interest rate spread between the short-term rates that they paid and the long-term rates that they received. When short-term interest rates were raised by the Federal Reserve (in response to elevated inflation), S&Ls lost their profit center. Many entered into riskier loans to make up the difference. The result was a collapse of their industry that required a federal bailout. Banks have risk mitigation tools in the form of duration matching between assets and liabilities and various derivatives products.

Liquidity risk is the potential for loss that results from short-term funding issues. The collapses of Lehman Brothers, Continental Illinois, and Northern Rock all illustrated the danger inherent with this risk. Each of these banks funded long-term assets (i.e., loans) with short-term funding sources. This created financial disasters when the short-term funding was no longer available due to external events. Banks must balance the need to reduce liquidity risk with the cost of doing so.

When considering the implementation of a hedging strategy, a firm must choose between a static hedge and a dynamic (rolling) hedge. A static hedge is easy to implement but difficult to calibrate to changing market conditions. A dynamic hedge is flexible but it presents liquidity risk (both funding and potentially trading liquidity risks) when long-term liabilities are hedged with short-term derivatives. The challenge of implementing a dynamic hedge was illustrated with a case study of Metallgesellschaft Refining and Marketing (MGRM).

Model risk can take many forms, including making improper assumptions, measuring relationships the wrong way, and deploying the wrong model overall. Several case studies show different vantage points for model risk. The Niederhoffer case showed the implications of wrong assumptions. The Long-Term Capital Management case illustrated the need to plan for risk metrics beyond 10-day value at risk (VaR), and a need to conduct stress testing with an eye to weathering short-term liquidity vacuums. The London Whale case highlighted that when risk limits are breached or trades look unprofitable, risk managers should never adjust assumptions or valuation models to make bad decisions look better.

A rogue trader can cause the collapse of an entire organization. This is exactly what happened to Barings Bank. A single rogue trader used accounting tricks to hide substantial losses. Eventually, the losses mounted to the point that a 200-year-old merchant bank closed its doors permanently. This could have been prevented with better internal controls flowing out of a healthy skepticism at reported results that differed from what should have been expected given the types of trades placed.

Financial engineering involves the use of forwards, futures, swaps, options, and securitized products to hedge risk. A firm could hedge a single risk or a combination of risks depending upon the hedging tool chosen. Risk managers should be aware of the temptation to migrate from a true hedging strategy to a speculative one. From considering cases on Bankers Trust,

Orange County, and Sachsen Landesbank, risk managers should clearly see the need to fully understand hedging tools before deploying them.

A company's reputation is the way in which the general public perceives the firm. Reputation risk is the potential for a negative operational outcome as a result of a negative fact or rumor about the firm. The three big constituents to watch for impact are customers, regulators, and shareholders.

Corporate governance is a system of policies and procedures that direct how a firm is operated. The Enron scandal is an excellent case study in governance failures. The board did not adequately supervise management. This was partly because the chairman of the board and the CEO were the same person. Management engaged in many types of unethical behavior, including the misuses of SPVs and creative accounting through aggressive revenue techniques. The end result of the failure of Enron (beyond the subsequent failure of its auditor, Arthur Anderson) was new regulation in the form of Sarbanes-Oxley. This new regulation seeks to promote accountability and corporate governance oversight.

Cyber risk is the risk of financial or reputational loss due to a cyberattack on internal technology infrastructure. The SWIFT case illustrates that the stakes are very high. Firms spend billions of dollars to secure their technology infrastructure and often purchase insurance to outsource their risks.

ANSWER KEY FOR MODULE QUIZZES

Module Quiz 9.1

1. **C** The S&L crisis highlighted the very real impact that unmanaged interest rate risk can have on a firm and an industry. Banks can mitigate their interest rate risk through duration matching between assets and liabilities and through the use of derivatives such as caps, floors, and swaps. Extending loans to longer terms would only increase the duration of the bank's assets and would therefore make the interest rate risk issue worse. (LO 9.a)

2. **C** Liquidity risk is most dangerous when long-term assets (i.e., loans) are funded with short-term liabilities (i.e., funding sources). Liquidity risk can be mitigated by (not result from) using costly long-term funding source. With asset/liability management (ALM), liquidity risk and interest rate risk are inverses. (LO 9.a)

3. **A** Dynamic hedging strategies are the best options for rapidly changing market environments. However, they require active supervision and will incur higher transaction costs than their static counterparts. A dynamic hedge uses short-term contracts, but there is no requirement that contracts must be monthly in tenure. A static hedging strategy involves buying a hedging instrument that closely matches the position to be hedged. (LO 9.a)

Module Quiz 9.2

1. **A** LTCM relied heavily on value-at-risk (VaR) modeling using a 10-day time horizon. A 10-day horizon is far too short a window to survive a short-term market shock. (LO

9.a)

2. **D** The Barings Bank case study highlights the need to separate supervision of the back-office and the front-office. Any trading profit that appears too good to be true or is strangely consistent over time should be treated with a healthy degree of skepticism. Rogue traders can sometimes try to hide economic reality by reporting performance only over favorable time periods. Management should consider the ultimate outcome of each aggregate strategy and not isolated time periods. (LO 9.a)

Module Quiz 9.3

1. **D** A rumored environmental issue will impact stakeholders as a result of reputation risk. Replacing packaging with sustainable sources does impact reputation, but it is not a risk element because it should cause reputational *gain* and not reputational *loss* for the firm involved. Attempts to hedge risk would not be considered a reputation risk unless there was an accounting fraud issue. (LO 9.a)
2. **C** From the Enron scandal, we have learned the importance of separating the roles of the chairman of the board and the CEO. The board should be providing supervision and oversight of management's policy and not leave oversight to only the CEO and the CFO. Aggressive accounting techniques should be avoided and scrutinized if discovered. The role of an independent auditor is to keep management accountable and not to approve management's policies to collect a fee. (LO 9.a)
3. **D** At its core, cyber risk is the risk of financial or reputational loss due to a breach of internal technology infrastructure. The importance of cyber risk is only growing as technology and digital money transfer are increasingly in use. This is a risk carried by any firm that transacts digitally, and firms can either address these concerns internally, hire an external IT consultant, and/or purchase cyber insurance to outsource the risk. (LO 9.a)

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[1] *JP Morgan Chase Whale Trades: A Case History of Derivatives Risks and Abuses*, United States Senate Permanent Subcommittee on Investigations, March 15, 2013.

The following is a review of the Foundations of Risk Management principles designed to address the learning objectives set forth by GARP®. Cross-reference to GARP FRM Part I Foundations of Risk Management, Chapter 10.

Reading 10

ANATOMY OF THE GREAT FINANCIAL CRISIS OF 2007–2009

Study Session 3

EXAM FOCUS

The financial crisis of 2007 to 2009 was caused by a complicated mix of relaxed lending practices, easy access to credit, inflated housing prices, and an interconnected banking and global financial system. For the exam, understand the background leading up to the financial crisis and the main factors that caused it. Be able to identify the dangers of short-term funding used by financial institutions and how it led to an increase in systemic risk. Finally, be able to assess government actions in response to the crisis.

MODULE 10.1: THE GLOBAL FINANCIAL CRISIS

Financial Crisis Overview and Contributing Factors

LO 10.a: Describe the historical background and provide an overview of the 2007-2009 financial crisis.

LO 10.b: Describe the build-up to the financial crisis and the factors that played an important role.

In the run-up to the financial crisis of 2007–2009, interest rates in the United States were kept at historically low levels. The cheap cost of money made it easier for people to borrow and acquire real estate property, thus fueling a rapid and unsustainable increase in house prices.

Financial innovations, such as securitization, also meant that mortgages could now be easily originated by lenders, repackaged, and sold to investors seeking higher yields—thus, reducing the credit risk borne by the originators. This led to originating banks becoming less concerned with the credit quality of their borrowers, which then led to more relaxed lending standards. Therefore, subprime mortgages became increasingly popular in the years preceding the crash because they offered a much higher yield in an environment of very low interest rates. However, unlike previous U.S. crises, what started as a subprime problem quickly escalated to other asset classes and spread to other geographical locations, eventually impacting markets around the world.

Many banks, especially the ones with exposure to subprime, experienced large losses and liquidity issues. Institutions became overly cautious, hoarding excess reserves and unwilling to lend those reserves to other cash-strapped institutions. Governments around the world intervened by lowering interest rates and providing liquidity support to encourage lending in an effort to prop up failing financial entities.

Banks increasingly financed their long-term assets through short-term liabilities. This gave rise to a maturity mismatch between the duration of the assets and the liabilities, which exposed banks to significant liquidity risk. When the crisis struck and house prices stalled, those short-term liabilities could not be rolled over.

At the peak of the crisis in September 2008, the large U.S. investment bank, Lehman Brothers, declared bankruptcy, which triggered a massive loss of confidence and froze the interbank lending market. Other investment banks, which avoided outright failure, were either bought out by competitors or converted to bank holding companies and became regulated by the Federal Reserve. Two of the large mortgage-backed securities (MBS) issuers in the United States, Fannie Mae and Freddie Mac, were nationalized, and the large financial services and insurance company, American International Group (AIG), was bailed out to prevent further systemic issues.

Subprime Mortgages and Collateralized Debt Obligations

LO 10.c: Explain the role of subprime mortgages and collateralized debt obligations (CDOs) in the crisis.

LO 10.d: Compare the roles of different types of institutions in the financial crisis, including banks, financial intermediaries, mortgage brokers and lenders, and rating agencies.

A subprime mortgage is a loan secured by residential property and made to a borrower of poor credit. Subprime borrowers may have a history of delinquent payments, large loan-to-values (low up-front deposits) or large loan-to-income ratios. A typical subprime loan could be structured as a 30-year 2-28 adjustable-rate mortgage (ARM). This type of product comes with a 2-year relatively low fixed **teaser rate**, which then reverts to a much higher (and possibly unaffordable) variable rate for the remaining 28 years of the mortgage. This was further compounded by the fact that some of these mortgages were as follows:

- *100% loan-to-value*—no up-front payment required and therefore no equity cushion to mitigate losses for the lender in the event of default
- *Interest-only*—only servicing the interest cost during the life of the mortgage without reducing the outstanding principal
- **NINJA loans**—loans to borrowers with no income, no job, and no assets
- **Liar loans**—loans for which little evidence was collected to confirm employment and income claims of the applicant

The hope of many of these subprime borrowers, some of whom were property speculators, was that as house prices continued to soar, they would be able to refinance to a similar or even better product at the end of their teaser period, or sell the house for profit. As house prices declined, many of these borrowers found themselves in a situation of negative equity

(mortgage loan values exceeding the value of the house) and opted to walk away and default on their obligations, resulting in an increased number of foreclosures and oversupply of properties, which further depressed house prices.

The reduction in lending standards partly resulted from the move to the so-called **originate-to-distribute** (OTD) model. Under this model, lenders no longer hold the mortgages on their balance sheet but move them into bankruptcy-remote **structured investment vehicles** (SIVs) through securitization. **Securitization** involves the pooling of assets together in order to sell claims against them. An example of such structure is the **collateralized debt obligation** (CDO) whereby the pool is sliced into multiple *tranches* (e.g., senior, junior, and equity). Cash flows and defaults are determined as per the **waterfall structure** whereby senior tranches receive cash flows first but absorb losses last. The senior tranches were considered very safe and structured to have a AAA rating, even though the underlying mortgages consisted of NINJA and liar loans. The junior tranches of multiple CDO structures were then often bundled together and repackaged as CDO-squared (a CDO whose cash flows are backed by other CDO tranches, rather than mortgages). It is clear that the structures were very opaque and complex to value, even during normal times and even for sophisticated investors who did not have the expertise to understand what they were buying.

The fact that senior CDO tranches were given a AAA rating demonstrates that rating agencies provided unrealistically high ratings, which were often based on historical data for prime mortgages and did not take into account the increasingly speculative nature of the marketplace. Rating agencies often relied heavily on data provided by the issuers without performing their own checks. This was further exacerbated by a conflict of interest whereby rating agencies were paid by the issuer and, therefore, incentivized to provide favorable ratings.

The huge demand for subprime mortgages resulted in questionable practices by some lenders and mortgage brokers. The compensation structure for originating a mortgage was typically based on quantity rather than quality of the mortgages. In other words, the suitability of the mortgage for a particular borrower was often ignored, resulting in many subprime mortgages sold to people who could not afford them or to people who could qualify for cheaper products.

Short-Term Funding and Systemic Risk

LO 10.e: Describe trends in the short-term wholesale funding markets that contributed to the financial crisis, including their impact on systemic risk.

As previously stated, banks created SIVs, which increasingly financed their purchases of long-term assets, such as mortgages, through the issuance of short-term liabilities. This was motivated by a desire to reduce funding costs, but it resulted in an asset-liability maturity mismatch. The two instruments used for short-term funding were asset-backed commercial paper (ABCP) and repurchase agreements (i.e., repos).

Commercial paper is a short-term, unsecured form of financing primarily used by high-quality issuers. ABCP is a special case whereby the commercial paper is backed by some form of collateral, such as credit card loans or mortgages. Due to the short-term nature of

commercial paper, there is an inherent assumption that the issuer will be able to roll over the obligation at maturity.

Repurchase agreements (i.e., repos) are another source of short-term funding used by many financial institutions. In a repo, a bank will sell an asset but will also simultaneously agree to buy back the asset in the future at a slightly higher price. The difference between the repurchase price and the sales price is the interest cost for the duration of the borrowing, known as the *repo rate*. Repos are considered a secured form of short-term borrowing because the sold asset acts as collateral for the borrowing arrangement. Should the borrower fail to pay at maturity, the lender is entitled to keep (or sell) the collateral without going through the bankruptcy courts. The collateral could be government bonds or high-quality corporate bonds. Depending on the quality of the collateral, a *haircut* is determined at the outset to reduce the credit risk. For example, if the lender is willing to pay $90 for an asset worth $100, then the haircut is 10%.

Because SIVs holding mortgages were primarily funded short term through ABCP and repos, they relied heavily on their ability to roll over these obligations at maturity. This exposed the SIVs to significant funding liquidity risk in the event of crisis. As house and mortgage-backed security prices declined, lenders started questioning the quality of assets residing within the SIV structures and became reluctant to extend further short-term loans. This eventually led to a complete shutdown of the ABCP and repo market by August 2007. The banks that had sponsored the SIVs were also affected because they had often extended backstop lines of credit to those entities. Other players were also affected. For example, money market funds had significant exposure to ABCP. The declining ABCP prices resulted in a run on money market funds by institutional and other large investors, which further exacerbated the liquidity crisis. Many hedge funds were unable to roll over their debt forcing them to start selling their CDO investments and other higher-quality assets to meet margin calls.

As mentioned, what started as a subprime problem quickly extended to the rest of the market as participants questioned the viability of all financial institutions. Haircuts increased from 0% before the crisis to nearly 45% in September 2008 following the Lehman default. The LIBOR-overnight index swap (OIS) spread, an indicator of the overall health of the financial system, rose from nearly 0% precrisis to over 3.6% at the peak of the crisis. A higher LIBOR-OIS spread indicates higher perceived credit risk and reluctance to lend in the interbank market. Higher haircuts and inability to borrow forced institutions to deleverage by selling some of their positions, which further depressed prices and eroded the equity of those institutions, forcing them to seek help from the government or competitors or, if all else failed, file for bankruptcy. The events of the crisis illustrate the idea of **systemic risk**, or risk of system failure resulting in the shutdown of the entire financial market due to vulnerabilities, such as the aforementioned asset-liability maturity mismatch.

The lesson learned is that even when a bank believes it has sufficient capital, overreliance on short-term funding sources is very dangerous because this type of funding can disappear overnight during times of crisis.

Central Bank Intervention

LO 10.f: Describe responses made by central banks in response to the crisis.

To prevent further systemic issues, the Federal Reserve and other central banks around the world intervened by providing liquidity support and lowering interest rates. Some of the actions taken by the Federal Reserve included the following:

- Providing long-term loans secured by high-quality collateral
- Allowing investment banks and securities firms to borrow directly from the Fed via the discount window (this was unavailable to investment banks precrisis)
- Providing liquidity against high-quality illiquid assets
- Providing funding to purchase asset-backed commercial paper
- Acquiring assets issued by Fannie Mae and Freddie Mac

These actions resulted in the huge expansion of the balance sheets of central banks around the world. Specific government interventions implemented in the United States during the crisis include the following:

- **Term Auction Facility (TAF)**—providing funds to depository institutions
- **Primary Dealer Credit Facility (PDCF)**—Fed lending to primary dealers via repos
- Government bailout of Fannie Mae and Freddie Mac in September 2008
- **Troubled Asset Relief Program (TARP)**—purchasing toxic assets from financial institutions starting October 2008

MODULE QUIZ 10.1

1. One of the contributory factors of the financial crisis of 2007–2009 was the move to the originate-to-distribute model. Under this model, the lender:
   A. may relax its underwriting standards.
   B. needs to hold more regulatory capital.
   C. is less likely to originate high loan-to-value mortgages.
   D. originates mortgages and then retains them on its balance sheet until they mature.
2. Which of the following statements is incorrect in relation to the use of collateralized debt obligations (CDO) during the financial crisis?
   A. Some CDO tranches were repackaged into CDO-squared.
   B. CDOs were opaque and complex to value, especially at the peak of the crisis.
   C. Cash flows and defaults were determined according to a waterfall structure.
   D. Despite containing subprime mortgages, investors could safely rely on the assessment given by the rating agencies.
3. The use of asset-backed commercial paper (ABCP) and repurchase agreements (repos) by banks to fund investment mortgages led to problems because:
   A. the commercial paper was unsecured.
   B. it exposed banks to funding liquidity risk.
   C. the duration of the liabilities exceeded the duration of the assets.
   D. rating agencies provided unrealistically high ratings for the assets.
4. To prevent further liquidity issues, the Federal Reserve and the U.S. government intervened in financial markets by implementing all of the following except:
   A. lowering interest rates.
   B. bailing out major financial institutions.
   C. opening the discount window to commercial banks.
   D. acquiring assets issued by major financial institutions.

KEY CONCEPTS

LO 10.a

In the run-up to the financial crisis of 2007–2009, interest rates were kept low and there was easy access to credit, which fueled a rapid increase in house prices.

LO 10.b

Several factors contributed to the financial crisis. The move to the originate-to-distribute model meant that banks relaxed their lending standards, thus fueling growth in subprime lending. Institutions increasingly funded themselves using short-term facilities, increasing liquidity risk in the system. The Lehman Brothers default, among other events, caused a loss of confidence with banks refusing to lend to each other and ultimately requiring central banks to intervene and provide liquidity support.

LO 10.c

Subprime mortgages are residential loans to borrowers of high risk. These mortgages were securitized and repackaged as collateralized debt obligations (CDOs), which had a much higher credit rating, thus hiding the true risk of the underlying assets. These products were difficult to understand and value. When the financial crisis began, market participants were unable to properly value CDOs.

LO 10.d

Due to the originate-to-distribute model, banks relaxed their lending standards beyond reason. Mortgage brokers focused on quantity rather than quality often pushing unsuitable products to their clients in search of higher commission. Rating agencies provided unrealistically high ratings, especially in relation to senior CDO tranches backed by subprime mortgages.

LO 10.e

Banks increasingly funded their long-term assets via short-term funding sources such as asset-backed commercial paper and repos. This exposed them to significant funding liquidity risk in the event of a crisis. The decline in house prices ultimately led to short-term lenders refusing to roll over their loans, leading to a near complete shutdown of the financial market.

LO 10.f

To prevent further systemic risks, central banks around the world intervened by lowering interest rates and providing liquidity support. This came at the cost of massive increases in central bank balance sheets.

ANSWER KEY FOR MODULE QUIZZES

Module Quiz 10.1

1. **A** Under the originate-to-distribute model, a lender sells mortgages to special investment vehicles (SIV), which issue collateralized debt obligations (CDOs). As the

credit risk associated with the mortgage is transferred to other investors, the lender will need to hold less regulatory capital and relax its lending criteria. (LO 10.c)

2. **D** Rating agencies provided unrealistically high assessment of CDOs, especially of the senior tranches. This was partly due to the conflict of interest that existed between the rating agencies and the issuers of CDO structures. (LO 10.c)

3. **B** Banks funded long-term assets, such as mortgages, using short-term funding sources, such as asset-backed commercial paper (ABCP) and repos. This exposed them to funding liquidity risk in times of crisis when lenders refused to roll over these short-term funding sources. (LO 10.e)

4. **C** Historically, the discount window was available to commercial banks to meet their reserve requirements at the close of each day. At the peak of the crisis, the discount window was also made available to investment banks. (LO 10.e)

The following is a review of the Foundations of Risk Management principles designed to address the learning objectives set forth by GARP®. Cross-reference to GARP FRM Part I Foundations of Risk Management, Chapter 11.

Reading 11

GARP CODE OF CONDUCT

Study Session 3

EXAM FOCUS

This reading addresses the GARP Code of Conduct which sets forth principles related to ethical behavior within the risk management profession. FRM candidates are expected to know all Member responsibilities as well as sanctions that could result if violations of the Code occur. The material in this reading is relatively easy to understand; however, for the exam, you should expect complex questions related to these ethical standards that test whether or not a violation has occurred.

MODULE 11.1: GARP CODE OF CONDUCT

The GARP Code of Conduct contains a set of key principles designed to support financial risk management practices. The Code was developed for the Financial Risk Manager (FRM) program as well as other certification programs administered by the Global Association of Risk Professionals (GARP). All GARP Members (including FRM candidates) are expected to abide by the principles outlined in the Code and are subject to consequences, such as suspensions, for violating any parts of the Code.

A GARP Member should understand that high ethical behavior goes beyond the principles addressed in this reading. When encountering a situation not specifically outlined in the Code, Members are always expected to act in an ethical fashion. Acting with prudence in all situations related to the profession will uphold the integrity of the risk management field as well as risk management practitioners.

The Code of Conduct stresses ethical behavior in two areas: (1) Principles and (2) Professional Standards. The Principles section addresses: (1) professional integrity and ethical conduct, (2) conflicts of interest, and (3) confidentiality. The Professional Standards section addresses: (1) fundamental responsibilities and (2) adherence to generally accepted practices in risk management. The responsibilities listed in each section are examined in the following learning objective.

LO 11.a: Describe the responsibility of each GARP Member with respect to professional integrity, ethical conduct, conflicts of interest, confidentiality of information, and adherence to generally accepted practices in risk management.

1. Professional Integrity and Ethical Conduct

GARP Members:

1.1. shall act professionally, ethically and with integrity in all dealings with employers, existing or potential clients, the public, and other practitioners in the financial services industry.

1.2. shall exercise reasonable judgment in the provision of risk services while maintaining independence of thought and direction. GARP Members must not offer, solicit, or accept any gift, benefit, compensation, or consideration that could be reasonably expected to compromise their own or another's independence and objectivity.

1.3. must take reasonable precautions to ensure that the Member's services are not used for improper, fraudulent or illegal purposes.

1.4. shall not knowingly misrepresent details relating to analysis, recommendations, actions, or other professional activities.

1.5. shall not engage in any professional conduct involving dishonesty or deception or engage in any act that reflects negatively on their integrity, character, trustworthiness, or professional ability or on the risk management profession.

1.6. shall not engage in any conduct or commit any act that compromises the integrity of GARP, the FRM® designation, or the integrity or validity of the examinations leading to the award of the right to use the FRM designation or any other credentials that may be offered by GARP.

1.7. shall be mindful of cultural differences regarding ethical behavior and customs, and avoid any actions that are, or may have the appearance of being unethical according to local customs. If there appears to be a conflict or overlap of standards, the GARP Member should always seek to apply the highest standard.

2. Conflict of Interest

GARP Members shall:

2.1. act fairly in all situations and must fully disclose any actual or potential conflict to all affected parties.

2.2. make full and fair disclosure of all matters that could reasonably be expected to impair independence and objectivity or interfere with respective duties to their employer, clients, and prospective clients.

3. Confidentiality

GARP Members:

3.1. shall not make use of confidential information for inappropriate purposes and unless having received prior consent shall maintain the confidentiality of their work, their employer or client.

3.2. must not use confidential information for personal benefit.

4. Fundamental Responsibilities

GARP Members shall:

4.1. comply with all applicable laws, rules, and regulations (including this Code) governing the GARP Members' professional activities and shall not knowingly participate or assist in any violation of such laws, rules, or regulations.

4.2. have ethical responsibilities and cannot outsource or delegate those responsibilities to others.

4.3. understand the needs and complexity of their employer or client, and should provide appropriate and suitable risk management services and advice.

4.4. be diligent about not overstating the accuracy or certainty of results or conclusions.

4.5. clearly disclose the relevant limits of their specific knowledge and expertise concerning risk assessment, industry practices, and applicable laws and regulations.

5. Best Practices

GARP Members shall:

5.1. execute all services with diligence and perform all work in a manner that is independent from interested parties. GARP Members should collect, analyze and distribute risk information with the highest level of professional objectivity.

5.2. be familiar with current generally accepted risk management practices and shall clearly indicate any departure from their use.

5.3. ensure that communications include factual data and do not contain false information.

5.4. make a distinction between fact and opinion in the presentation of analysis and recommendations.

Violations of the Code of Conduct

LO 11.b: Describe the potential consequences of violating the GARP Code of Conduct.

All GARP Members are expected to act in accordance with the GARP Code of Conduct as well as any local laws and regulations that pertain to the risk management profession. If the Code and certain laws conflict, then laws and regulations will take priority.

Violations of the Code of Conduct may result in temporary suspension or permanent removal from GARP membership. In addition, violations could lead to a revocation of the right to use the FRM designation. Sanctions would be issued after a formal investigation is conducted by GARP.

MODULE QUIZ 11.1

1. Over the past two days, Lorraine Quigley, FRM, manager of a hedge fund, has been purchasing large quantities of Craeger Industrial Products' common stock while at the same time shorting put options on the same stock. Quigley did not notify her clients of the trades although they are aware of the fund's general strategy to generate returns. Which of the following statements is most likely correct? Quigley:

A. did not violate the Code.
B. violated the Code by manipulating the prices of publicly traded securities.
C. violated the Code by failing to disclose the transactions to clients before they occurred.
D. violated the Code by failing to establish a reasonable and adequate basis before making the trades.

2. Jack Schleifer, FRM, is an analyst for Brown Investment Managers (BIM). Schleifer has recently accepted an invitation to visit the facilities of ChemCo, a producer of chemical compounds used in a variety of industries. ChemCo offers to pay for Schleifer's accommodations in a penthouse suite at a luxury hotel and allow Schleifer to use the firm's private jet to travel to its three facilities located in New York, Hong Kong, and London. In addition, ChemCo offers two tickets to a formal high-society dinner in New York. Schleifer declines to use ChemCo's corporate jet or to allow the firm to pay for his accommodations but accepts the tickets to the dinner (which he discloses to his employer) since he will be able to market his firm's mutual funds to other guests at the dinner. Has Schleifer violated the GARP Code of Conduct?
   A. Yes.
   B. No, since he is using the gifts accepted to benefit his employer's interests.
   C. No, since the gifts he accepted were fully disclosed in writing to his employer.
   D. No, since the gift he accepted is of nominal value and he declined to accept the hotel accommodations and the use of ChemCo's jet.

3. Beth Bixby, FRM, oversees a mid-cap fund that is required to invest in a minimum of 40 and a maximum of 60 different issues. Bixby uses a quantitative approach to actively manage the assets. In promotional materials, she states that "through our complex quantitative approach, securities are selected that have similar exposures to a number of risk factors that are found in the S&P 500 Index. Thus the fund is designed to track the performance of the S&P 500 Index but will receive a return premium of between 2% and 4% according to our model's risk-return measures." This statement is:
   A. permissible since the assertion is supported by modern portfolio theory and estimates from the firms' model.
   B. not permissible since Bixby is misrepresenting the services that she and/or her firm are capable of performing.
   C. not permissible since Bixby is misrepresenting the investment performance she and/or her firm can reasonably expect to achieve.
   D. permissible since the statement describes the basic characteristics of the fund's risk and return objectives.

4. Gail Stefano, FRM, an analyst for a U.S. brokerage firm that serves U.S. investors, researches public utilities in South American emerging markets. Stefano makes the following statement in a recent report: "Based on the fact that the South American utilities sector has seen rapid growth in new service orders, we expect that most companies in the sector will be able to convert the revenue increases into significant profits. We also believe the trend will continue for the next three to five years." The report goes on to describe the major risks of investing in this market, in particular the political and exchange rate instability associated with South American countries. Stefano's report:
   A. has not violated the Code.
   B. violated the Code by failing to properly distinguish factual information from opinions.
   C. violated the Code by recommending an investment which would not be suitable for all of its clients.
   D. violated the Code by failing to properly identify details related to the operations of South American utilities.

5. Beth Anderson, FRM, is a portfolio manager for several wealthy clients including Reuben Carlyle. Anderson manages Carlyle's personal portfolio of stock and bond investments. Carlyle recently told Anderson that he is under investigation by the IRS for tax evasion

related to his business, Carlyle Concrete (CC). After learning about the investigation, Anderson proceeds to inform a friend at a local investment bank so that they may withdraw their proposal to take CC public. Which of the following is most likely correct? Anderson:

A. violated the Code by failing to immediately terminate the client relationship with Carlyle.
B. violated the Code by failing to maintain the confidentiality of her client's information.
C. violated the Code by failing to detect and report the tax evasion to the proper authorities.
D. did not violate the Code since the information she conveyed pertained to illegal activities on the part of her client.

PROFESSOR'S NOTE

There are no Key Concepts for this short reading.

ANSWER KEY FOR MODULE QUIZZES

Module Quiz 11.1

1. **A** Quigley's trades are most likely an attempt to take advantage of an arbitrage opportunity that exists between Craeger's common stock and its put options. She is not manipulating the prices of securities in an attempt to mislead market participants. She is pursuing a legitimate investment strategy. Participants in her hedge fund are aware of the fund's investment strategy, and thus Quigley did not violate the Code by not disclosing this specific set of trades in advance of trading (Standards 2.1 and 5.1). (LO 11.a)

2. **A** GARP Members must not offer, solicit, or accept any gift, benefit, compensation, or consideration that could be reasonably expected to compromise their own or another's independence and objectivity. Schleifer has appropriately rejected the offer of the hotel accommodations and the use of ChemCo's jet. However, Schleifer cannot accept the tickets to the dinner. Since it is a formal high-society dinner, the tickets are most likely expensive or hard to come by. Even though he has disclosed the gift to his employer and he plans to use the dinner as a marketing opportunity for his firm, the gift itself may influence Schleifer's future research in favor of ChemCo. Allowing such potential influence is a violation of Professional Integrity and Ethical Conduct (Standard 1.2). (LO 11.a)

3. **C** It is not reasonable for Bixby to expect a 40-to-60 stock mid-cap portfolio to track the entire S&P 500 Index, which is a large-cap index. She should know that there will be periods of wide variance between the performance of the portfolio and the S&P 500 Index. There is no assurance that a premium of 2% to 4% will consistently be obtained. Bixby is in violation of Standard 1.4: "GARP Members shall not knowingly misrepresent details relating to analysis, recommendations, actions, or other professional activities," since she has made an implicit guarantee of the fund's expected performance. (LO 11.a)

4. **A** Historical growth can be cited as a fact since it actually happened. Stefano states that her firm expects further growth and profitability which is an opinion. She does not claim that these are facts. Thus, she is not in violation of Standard 5.4. In addition, Stefano identifies relevant factors and highlights in particular the most significant risks of investing in South American utilities. She has fully complied with Standard 5.3. (LO 11.a)

5. **B** Anderson must maintain the confidentiality of client information according to Standard 3.1. Confidentiality may be broken in instances involving illegal activities on the part of the client, but the client's information may only be relayed to proper authorities. Anderson did not have the right to inform the investment bank of her client's investigation. (LO 11.a)

FORMULAS

Reading 1

expected loss: EL = EAD × PD × LGD

risk-adjusted return on capital:

RAROC = after-tax risk-adjusted expected return / economic capital

Reading 5

capital market line:

$$E(R_P) = R_F + \left[\frac{E(R_M) - R_F}{\sigma_M}\right]\sigma_P$$

beta:

$$\beta_i = \frac{\text{covariance of Asset i's return with the market return}}{\text{variance of the market return}} = \frac{Cov_{i,M}}{\sigma_M^2} = \rho_{i,M} \times \frac{\sigma_i}{\sigma_M}$$

capital asset pricing model: $E(R_i) = R_F + [E(R_M) - R_F]\beta_i$

Sharpe measure: $SPI = \left[\frac{E(R_P) - R_F}{\sigma_P}\right]$

Treynor measure: $TPI = \left[\frac{E(R_P) - R_F}{\beta_P}\right]$

Jensen's alpha: $JPI = \alpha_P = E(R_P) - \{R_F + [E(R_M) - R_F]\beta_P\}$

tracking error $= \sqrt{\frac{\sum(R_P - R_B)^2}{n-1}}$

information ratio: $IR = \frac{E(R_P - R_B)}{\text{tracking error}} = \frac{\text{active return}}{\text{active risk}}$

Sortino ratio $= \frac{R_P - R_{MIN}}{\text{downside deviation}}$

Reading 6

arbitrage pricing theory:

$$E(R_i) = R_F + \beta_1 RP_1 + \beta_2 RP_2 + \beta_3 RP_3 + e_i$$

where:
β_i = the beta (factor sensitivity) between stock *i* and factor exposure *i*
RP_i = risk premium associated with risk factor *i*

Fama-French three-factor model:

$$E(R_i) = R_F + \beta_{i,M} RP_M + \beta_{i,SMB} F_{SMB} + \beta_{i,HML} F_{HML} + e_i$$

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